A. Elmrini · A. Elibrahimi · O. Agoumi · F. Boutayeb ·
M. Mahfoud · A. Elbardouni · M. Elyaacoubi

Ipsilateral fractures of tibia and femur or floating knee

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Abstract Ipsilateral fractures of the femur and the tibia are relatively uncommon lesions, with critical consequences to the knee. We report a series of 18 ipsilateral fractures of the femur and the tibia treated at the Department of orthopaedics, CHU Hassan II of Fez, over an eight-year period (1996–2004). Various surgical procedures were used, in particular, intramedullary nailing. After an average follow-up of 2.5 years, we re-examined the 18 patients. The functional results were evaluated using the Schiedts' criteria, and we had seven excellent results (38.9%), six good (33.4%), and five bad (27.8%). There was one major lesion of the popliteal artery that led to an emergency amputation, two cases of osteitis, one septic non-union, one case of late deep sepsis, one insignificant shortening of 2 cm, two cases of varus, three cases of stiffness, and one ankylosis of the knee. Through this work we will try to show the repercussions of this type of fracture of the knee and to evaluate our therapeutic choices.

Résumé Les fractures ipsilatérales du fémur et du tibia sont des fractures relativement rares. Nous rapportons une série de 18 patients traités pour fractures ipsilatérales du fémur et du tibia au service de traumatologie-orthopédie CHU Hassan II de Fès, colligés sur une période de 8 ans (1996–2004). Différents procédés chirurgicaux ont été employés, dominés notamment par l'enclouage centromédullaire. Sur un recul moyen de 2 ans et demi, nous avons revu les 18 patients ; les résultats ont été jugés sur les

critères adoptés par Schiedts, nous avons eu 7 excellents résultats (38,9%), 6 bons (33,4%) et 5 mauvais (27,8%). On a déploré une amputation sur une lésion majeure de l'artère poplitée, deux cas d'ostéites, une pseudarthrose septique, un sepsis profond tardif, un raccourcissement de 2 cm et deux cas de varus non significatifs, 3 cas de raideur et une ankylose du genou. A travers ce travail, nous essayons de relater les répercussions de ce type de fracture sur le genou et d'évaluer nos choix thérapeutiques.

Introduction

Ipsilateral fractures of the tibia and femur are referred to as floating knees. They may involve, shaft, metaphysis or articular surfaces. The fractures are often a result of high energy trauma and may be associated with life-threatening injuries. Fracture patterns are often complex with serious injuries of the soft tissues. Articular, meniscal, ligament, and vascular injuries and their complications (pulmonary embolism, infection, non-union, amputation, malunion, ankylosis, and instability of the knee) are common.

The purpose of this study is to assess the impact of these types of fractures on knee function, and to guide our therapeutic choices.

Materials and methods

We report a series of 18 ipsilateral fractures of the femur and the tibia treated at the Department of Orthopaedics, UH Hassan II of Fez, over an eight-year period (1996–2004). The mean age of our patients was 35 years old, and there were 15 men and three women. The right side was frequently involved (ten cases), and the main aetiology was road traffic accidents (18 cases). Fraser has classified these fractures according to [1] the articular involvement of the knee (Table 1). There were ten cases of type I, and eight cases of type II of which four cases were of type II^a, three of type II^b, and one case of type II^c. Articular involvement was found in eight cases, representing 45%, of which four

A. Elmrini · A. Elibrahimi · O. Agoumi · F. Boutayeb ·
M. Mahfoud · A. Elbardouni · M. Elyaacoubi
Department of Orthopaedics, UH Hassan II Fez,
UH Avicenne Rabat,
Fez, Morocco

A. Elmrini (✉)
No. 8, Res Ahlen,
Ait Sqato 2, Rte Imouzer,
Fez, Morocco
e-mail: traumajid@yahoo.fr
Tel.: +212-61-107741
Fax: +212-37-370410

affected the femoral bone and five the tibial bone. Skin wounds were noticed in 12 cases representing 70%, of which five are of type III of the Gustilo classification. Overall, associated injuries were dominated by bone injuries; on the ipsilateral side we recorded one case of the fracture of each of the following bones: acetabulum, ulnar shaft, trochanter, the medial and lateral malleolus, and the superior extremity of the humerus. On the contralateral side we found one case of tibial and two cases of femoral shaft fracture. There was also one arterial injury that required amputation and one case of a head injury. Urgent wound care, fluid replacement, and antibiotic therapy were undertaken for open fractures. Femoral and tibial fractures were dealt with at the same time, by dealing with the femoral bone first unless the tibial fracture was open. Various methods of osteosynthesis are represented in Table 2, intramedullary nailing being the most common (Fig. 1).

Results

After an average period of 2.5 years, we re-examined the 18 patients. The functional results were evaluated using Schiedts' criteria and we obtained seven excellent results (38.9%), six good (33.4%), and five bad (27.8%). There was one major lesion of the popliteal artery that led to amputation after unsuccessful repair and two cases of deep infection following open fractures types II and III, which were treated by external fixation. In the first of these two patients osteitis followed cleansing and bone graft; the second had septic non-union; and late deep sepsis was noticed in the patient with the open type II fracture of the tibia that was treated by plate and screws. There was one inconsequential shortening of 2 cm, two cases of varus, three cases of stiffness, and one ankylosis of the knee.

Discussion

Ipsilateral fractures of the femur and tibia are relatively uncommon [2]. The word floating knee was coined for the first time by McBryde in 1965 [3, 4]. It often follows road traffic accidents and frequently affects active people. This kind of trauma is often of high energy, which may lead to complex fractures and extensive soft tissue injuries, which can be potentially life threatening; therefore, trauma of the floating knee can be difficult to manage. Although the operative treatment is specific to each fracture, operative

Table 2 Surgical techniques

Osteosynthesis modality	Femur	Tibia
Centromedullary nailing	6	5
External fixator	2	3
Maitezeau pinning	3	3
Screwed plate	3	7
Blade plate	1	—
Dynamic hip screw	1	—
Dynamic condylar screw	1	—

scheduling has to take injuries of other limbs and systems into consideration. Physiotherapy and early mobilisation are required to reduce complications and to obtain good functional results. Operative treatment is not standard, but nailing is still the basic modality.

Some authors have reported good results after internal fixation of both fracture sites; this technique has been followed by many orthopedic surgeons [5–8]. There have been fewer length problems, angular malunion, and secondary interventions following conservative treatment for floating knees in childhood [9]. However, although internal fixation is an excellent treatment, complications and mortality are still high [10]. Many studies have focused on complications and functional results after treatment, but there are few studies that call into question prognostic factors, especially those of bad functional results [11, 12]. Intramedullary nailing has been used in six femoral fractures and five tibial fractures with good results. Canal reaming and insertion of a nail liberates medullary fat with the risk of pulmonary embolism, which can be life-threatening because of a fragile respiratory state secondary to the initial trauma. Liberation of free fatty acids leads to endothelial injuries and pulmonary oedema. In theory, canal reaming performed during the same operation as femoral and tibial shafts may increase the risk of fat embolism. We did not experience these kinds of complication, even though the femoral and tibial osteosynthesis was carried out at the same operation. The osteosynthesis of the femur should be performed first with the exception of tibial Gustilo type III open fractures where wound care and external fixation take priority. Ipsilateral nailing of femoral and tibial shafts increases the risk of malunion, rotatory instability due to shortening, and axis defects [13]. Braten et al. [14] and Sojbjerg et al. [15] found this complication in 40% and 25% of cases respectively, but for Braten et al. in only 10% were the fractures to blame. The systematic use of locking screws did not prevent this problem: it is during intervention that the rotation error is established. The combination of ipsilateral shaft fractures is a reason for the shortening of lower limbs. Bonneville et al. [16] reported this complication in 20% of a series of 33 patients, but Alho et al. [17] found it in only 3% of patients who underwent tibial nailing. In order to reduce malunion, preliminary alignment by reduction and manipulation of tibial and femoral fractures facilitate reaming and avoid damage to the medullary canal. In our study, we did not notice any malunion of fractures treated by nailing.

Table 1 Fraser classification

Type I: both fractures involve the shaft with articular involvement of the knee.
Type II: articular involvement of the knee
Type IIa: tibial plateau fractures
Type IIb: intercondylar fractures (T or Y fractures) of the inferior extremity of the femur
Type IIc: both sites are articular

Fig. 1 Fraser type 1 left floating knee treated by nailing

However, malunion was found in three cases, representing 16% of cases of types II and III open fractures, and comminuted fractures treated by external fixation. In order to lessen the number of malunions, comminution must be assessed accurately and addressed by the use of locking screws. Bonneville et al. reported 15% knee ankylosis in cases of ipsilateral femoral and tibial fractures [16]. Recently, Hwan Tak et al. [18] reported 29% knee ankylosis in a series of 89 patients. Vangsness et al. [19] encountered many cases of meniscal and ligament injuries, with 25% meniscal lesions and 50% knee instability. We think that it is mandatory to check those injuries at the end of the intervention and treat them early. Earlier return to activities and higher excellent and good long-term functional results were observed among patients who underwent intramedullary nailing. External fixation of the fractured femur resulted in decreased range of movement at the knee due to quadriceps muscle fixation [20].

We found, like the majority of authors, that the use of intramedullary nailing in this kind of trauma leads to a low incidence of non-union, infectious complications, and malunion. In our series we estimated that fractures with the poorest prognosis are those in which many factors are involved, such as open fracture, infection, Fraser classification, and fracture comminution. However, the best results were seen in cases of extra-articular fractures treated by locked intramedullary nailing. Our results are similar to those reported by Fraser et al. [1], Bansal et al. [21], and especially those of Hwan Tak et al. [18] and Kazuhiko et al. [22] who established pre-operative prognostic factors for floating knees.

Conclusion

Ipsilateral fractures of the femur and tibia, or floating knee, are major injuries occurring frequently among an active population. To obtain a good functional result with no sequelae, the therapeutic choice depends on the Fraser classification, the existence or absence of bone comminution, articular type, and whether the fracture is open or closed. We recommend strong internal fixation at the same operation to facilitate the examination of the knee for any injuries and appropriate treatment of soft tissue injuries.

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