Rehabilitation Program in Type I Floating Knee: A Case Report

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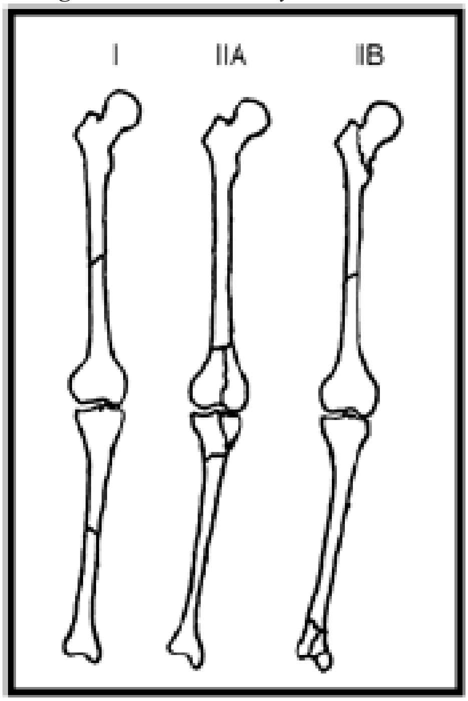
ABSTRACT

Study Design: Case report

Background: Type I floating knee is characterized by fracture of the femur and tibia shafts leading to a discontinuity of the knee joint. Despite the evidence in the literature about surgical treatment for these fractures, we found a lack of findings focusing the rehabilitation process. Thus, the aim of this study was to describe a specific rehabilitation program for a patient in postoperative type I floating knee. Case Description: This case is a young patient victim of automobile accident resulting in type I floating knee treated surgically with blocked intra-medullar nail of the femur and tibia. She was submitted to a rehabilitation program based on specific strengthening exercises, body conscience, and biomechanical correction, ending the physical therapy treatment after 7 months. Outcomes: After the rehabilitation period, the patient returned to her daily activities without pain complaints, 69 points in the lower extremities functional scale (LEFS), 20% muscle strength deficits for knee and hip extensors, 30% for knee flexors, 15% for hip abductors, 7% for hip adductors, and 20% for hip internal rotators. Hip flexors and lateral rotators, as well as dorsi-flexors and plantar-flexors strength were the same than the contra-lateral limb.

Discussion: The patient came to physical therapy sector using a wheelchair, pain complaints and significant musculature activation deficit. The rehabilitation focused strengthening specific muscles, lumbo-pelvic stabilization, and biomechanical cor-

***Figure 1**: Classification of floating knee according to Blake and McBryde [6]*



rection. Based on these clinical results, our rehabilitation protocol was satisfactory in a patient with type I floating knee.

BACKGROUND

Floating knee is characterized by knee joint discontinuity as a result of fractures of the ipsilateral femur and tibia shafts, and may be associated with soft tissue injury.[1] This fracture is usually caused by car accidents, accompanied in most cases to the head, thorax, and abdomen traumas, that result in a high incidence of morbidity / mortality (5-15%), 1 especially when associated with complications such as infection, fat embolism, weight-bearing deficits, and bone healing deficits (delayed consolidation or non-union).[2]

There is a poor prognosis for this fracture due to difficulties during the surgical procedure, mainly because of associated injuries. It is important to highlight the high incidence of concomitant vascular damage as a result of these injuries, which may lead to amputation.[2,3] Ligament injuries are also common and range between 30-45%. The anterior cruciate ligament is the most affected, and it can be associated with other ligament structures.[4,5]

According to Blake and McBryde,[6] , there are two types of floating knee: type I and II (Figure 1). Type I is the true floating knee because the knee joint is not directly involved, with involvementin only fractures of the femur and tibia shafts. In type II-A, there is knee joint involvement as well as shaft fractures. Type II-B is characterized by associated hip or ankle joint fractures.

When selecting surgical treatment, there is a consensus in the literature that the best option is fixation by intra-medullar nails in both fractures.[7] It is believed that better functional results can be achieved with this stabilization because it allows knee and ankle movement, early return to pre-injury activities, and accelerated bone healing.[8] There are reports in the literature of fracture stabilization procedures; however, few studies or case reports were observed that focus on rehabilitation programs and their influence on returning to prior functional status.

CASE REPORT

A 15 year-old female patient had presented right femur and tibia shaft fractures due to a motorcycle accident in May 2010. According to Blake and McBryde, this fracture was classified as type I floating knee (Figure 2).

One day after the fracture, she was submitted to external fixation (Figure 3), and after 3 days she was submitted to stabilization with retrogrades DFN (distal femur nail), and anterogrades ETN (expert tibial nail). Both nails were blocked (Figure 4). During the hospital period (between surgeries), physical therapy was initiated based on hip and ankle active-assisted mobilization.

The focus of the physical therapy was on flexion and extension, patellar mobilization, active exercises for the ankle, and orientations regarding limb positioning. After the second surgery, the physical therapy was performed utilizing the aforementioned exercises, including gait training with

__Figure 2__: Pre-operative anterior-posterior X-rays of floating knee – A) Femur shaft fracture and B) Tibia and fibula shaft fracture (may/10)

__Figure 3__ – X-rays immediately after surgery for external fixation - A) Femur fixation; B) Tibia fixation (May/10)

__Figure 4__ – X-rays immediately after surgery for open reduction internal fixation using intra-medullar nails – A) DFN; B) ETN (May/10)

proprioceptive weight-bearing with regular crutches. We also applied some analgesic procedures by neural-electrical stimulation. Thus, the patient finished the hospital physical therapy period, and on the 6th day after surgery, began ambulatory physical therapy.

Four days after leaving the hospital, the patient was admitted to the Rehabilitation Service while seated in a wheelchair and maintaining the limb in full extension. Clinical examination showed moderate knee edema, quadriceps activation deficit, and range of motion (ROM) around 30° for knee flexion, 25° for plantarflexion and 10° for dorsiflexion, as well as pain complaints in the injured limb (Visual Analogue Scale = 7).[9] Muscle strength measurement and ligament tests were not conducted at this time due to the pain presented by the patient. However, after approximately 1 month, these measurements were obtained and demonstrated a significant weakness of the quadriceps, hip abductors and lateral rotator muscles.[10]

The rehabilitation process lasted approximately 7 months and was divided into five phases, as described in Table 1. The frequency of sessions varied according to the specific rehabilitation phase, ie, 3 weekly sessions in the first two phases and two weekly sessions in the other phases.

Table 1: Rehabilitation program

- Knee ROM increased approximately 10 degrees per week, being that the initial evaluation (first week postoperative) showed 30 degrees and the 12 week evaluation showed approximately 140 degrees of flexion.
- Ankle ROM reached normal values (20 degrees of dorsi-flexion and 45 degrees of plantar-flexion) in the fifth week rehabilitation.

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- After this 7-month period, the patient returned to regular daily activities without pain complaints and with "satisfactory" function (scoring 69 points in the LEFS).[11]
- The post-operative clinical outcome was also considered "good" according to the criteria described by Karlström and Olerud.[12]

The muscular strength measurement in the final evaluation was performed by a hand-held dynamometer (Lafayette Instrument, Co).13 Despite this functional improvement, a certain strength deficit remains after therapy for knee and hip extensors (20%), knee flexors (30%), hip abductors, adductors and internal rotators (between 5-20%) in comparison to the contra-lateral limb. The muscle strength of the hip flexors and external rotators, as well as the ankle dorsi-flexors and plantar-flexors presented the same values when compared to the contra-lateral limb after the applied protocol.

DISCUSSION

This is a case description of a victim of a motorcycle accident with a diagnosis of type I floating knee that had been treated in the Rehabilitation Service of the Irmandade da Santa Casa de Misericórdia – São Paulo, Brazil. The patient was submitted initially to external fixation of both fractures, and subsequent internal fixation with retrograde intra-medullar nail for the femoral fracture, and anterograde intra-medullar nail for the tibial fracture. Physical therapy was performed for 7 months following injury. "Satisfactory" results were found at the end of treatment.

The literature shows that this fracture reduction can be obtained by external fixation or intra-medullar nails, since internal fixation is widely used due to advantages such as a lower risk of non-union, and a higher rate of consolidation.[14] In addition to these advantages, it is important to highlight that early weight bearing is also encouraged.[15] The placement of 2 nails using the same surgical incision present better functional outcome.[8, 16] According to some authors, the consolidation time of fractures treated by an intra-medullar nail, range between 14 to 24 weeks for the tibia and 12 to 27 weeks for the femur.[7,16] We corroborate these data in the present report, since the required time for fracture consolidation was approximately 15 weeks for the tibia and 16 weeks for the femur. Despite the high incidence of infection and consolidation deficits of this fracture,[2-17] we did not find post-operative complications.

We believe that an important aspect of the rehabilitation process concerns lumbo-pelvic stabilization.[18]. Exercises were performed to strengthen the transverse abdominal, multifidus, gluteus maximus, and medium muscles from the beginning of treatment. This protocol was designed to improve anticipatory postural adjustment and dynamical control of the lower limb. This dynamic stability provided by coordinated recruitment of this musculature contributes to force distribution and distal segments movement control.[19]

Another important factor of strength improvement is the ability of the central nervous system (CNS) to activate all available motor units during a voluntary contraction. When there is a delay or an activation deficit after articular trauma or surgical procedure, there is a mechanism named "arthrogenic inhibition."[20] Under these circumstances, important muscles such as the quadriceps and the gluteus medius can become rapidly inactivated.[21]

The relationship between hip and lower limb disorders has been well discussed. Muscular strength deficits in the hip joint can lead directly to biomechanical changes during lower limb activities. Among these changes, the "dynamic valgus" has been well described and studied in the literature.[10]. With the occurrence of a biomechanical alteration, there is excessive foot pronation that increases the femur adduction and medial rotation, and consequently, the pelvis deviation to the contra-lateral side during single-leg weight bearing. These changes can result in several overload responses in the lower limb joints.[22] The causes of this syndrome remains unclear, but some hypotheses have been raised, such as deficiencies in neuromuscular control, which in turn causes an imbalance in the actions of static and dynamic stabilizers of the lower limb joints.[23] Thus, in the applied protocol, we conducted hip abductor and lateral rotator muscle strengthening, as well as sensory-motor training based on the dynamic valgus correction. Initially, we applied postural conscience exercises, progressing to functional activities such as climbing-down stairs, squatting, plyometric exercises, etc.

Despite few detailed descriptions about floating knee rehabilitation, there are reports of a return to regular daily activities in around 7 months,[2,8] as occurred in the present case study. Due to the case report limitations, the scientific potential of this study is confined to the description of the rehabilitation protocol after floating knee injury. The anatomical, surgical, biomechanical, and bone consolidation knowledge should also be taken into consideration.

This patient presented a satisfactory outcome according to the functional scales, muscle strength measurements, and ROM. We would like to emphasize the key role of rehabilitation in patients with lower limbs fractures, specifically floating knee.

ADDITIONAL INFORMATION

We declare that there was no financial support, or any conflict of interest in the accomplishment of this study.

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