Revista de Chimie
https://revistadechimie.ro
https://doi.org/10.37358/Rev. Chim.1949

Osteosynthesis in Children with Titanium Elastic Nails in Ipsilateral Lower Limb Fractures

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Abstract. *Although we often find isolated lower limb fractures of the femur or tibia in children, ipsilateral fracture of both femur and tibia is a rarity among the pediatric population. The ipsilateral limb fracture is a rare event even in the adult patient population. The mechanism involved is most often one with high energy. The issue for pediatric surgeons and orthopedic pediatric surgeon remains relevant, as reported by this clinical case, due to the optimal orthopedic treatment of pediatric patients in this cases undefined. The interest arises from it being a clinical case involving ipsilateral fracture of femur, tibia and fibula associated with multisystem trauma sustained by the child. Titanium seems to be the ideal osteosynthesis material, especially in children with polytrauma, considering its chemical biocompatibility properties (being an inert material) and physical, its elasticity.*

Keywords*: ipsilateral fractures, child, minimally invasive osteosynthesis, titanium elastic nails*

1. Introduction

Patients presenting multiple injuries, including multiple fractures of long bones are candidates for general complications that are responsible of high morbidity and mortality [1]. The optimal timing and orthopedic approach for long bones fractures in polytrauma patients remain a challenge [2]. According to damage control orthopedics, the hemodynamic stability of the patient must be initially ensured and only then the orthopedic correction treatment must be applied [3]. The ipsilateral limb multiple fractures in children, although rare, remain a challenge for orthopedists, given the ways to technically solve them, as well as possible postoperative complications, early or late [4]. Regarding long bone osteosynthesis in children, the therapeutic attitude is still controversial. In children, for femoral and concomitant tibial shaft fractures, cast immobilization remains a safe, cheap and effective treatment [5], but in the presence of ipsilateral fractures with displacement, on the lower limb, requires a different approach [6]. In addition, the need for prolonged extension and immobilization, the presence of superficial skin lesions in the lower limb, the risk of displacement during orthopedic treatment impose a particular orthopedic approach in this case. The options of treatment for femoral and tibial shaft fracture remain controversial for orthopedics. In these conditions, the types of fractures rarely encountered in current practice represents an important practical interest, which became the reason for publishing our case report. The purpose of our study is to show applicability and superiority of osteosynthesis with titanium elastic nails in the ipsilateral fracture of the left lower limb in the case of a 7-year-old girl.

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2. Materials and methods

We present the case of a girl of 7 years old, who was admitted to our emergency department with ipsilateral fracture of left lower limb after a car accident. During our initial examination in the emergency room, we noted the patient was confused, vomiting, had difficulty moving, presented multiple lesions of soft parts (head and neck abrasions and contusions, facial abrasions and superficial wounds, thoracic wall hematoma and left abdominal flank hematoma) and left lower limb deformity with a 4 cm shortening and externally rotated. A left femoral shaft fracture (AO classification 32-A2), two left tibial fractures (proximal and shaft) and a proximal fibula fracture (AO classification 41-A1, 42-A2, 4F1-A1) were showed by radiographs of the lower limb (Figure 1).

Figure 1. Radiological aspects of fractures - left femoral shaft fractures (AO classification 32- A2), left tibial segmental fracture and fibula fracture (AO classification 41-A1, 42-A2,4F1-A1)

The patient presented a blood pressure of 85/55 mmHg with a pulse rate of 125/minutes and a temperature of 35,8°C (measured axillary). The complete blood count showed pathological values for white blood count (4900/mmc), a hemoglobin of 9.8 g/dL and hematocrit 24%. Laboratory testing for the liver and kidney revealed normal values. Considering the patient's state of confusion a neurological examination was requested in the form of a CT-scan. The brain CT-scan has identified diffuse cerebral edema. The abdominal CT-scan has identified splenic subcapsular hematoma grade I (<10% surface area). The clearing and wound dressing was done. Analgesic medication, physical rest and antibiotic therapy have been established. The patient was stabilized with spica cast and was scheduled for a closed reduction with internal fixation using titanium elastic osteosynthesis nail the next day, when, after hemodynamic stabilization and depleting treatment for cerebral edema using mannitol, the hemodynamic and neurological status of the patient allowed surgery. Close reduction, followed by internal fixation using titanium elastic nail (TEN) were performed for the ipsilateral tibial and femoral fracture (Figure 2). We used two identical titanium elastic nails (diameter of 3,5 mm). They were inserted retrograde through an entry point placed at distance from the focal point (to avoid damaging the growth cartilage) of the left femur which held the fracture in place. Two 2,5 mm titanium elastic nails were inserted through the entry point at distance from the focal point of left tibia, following the same principles of minimally invasive osteosynthesis. We have recommended cast immobilization for antalgic purposes for two weeks. Postoperative progression was favorable and the patient was discharged after 7 days and was prescribed partial weight bearing for another two weeks.

Figure 2. Radiological aspects of patient's fractures on the first day after minimally invasive osteosynthesis with titanium elastic nails

Radiological control after 30 days following the minimally invasive osteosynthesis with titanium elastic nails reveals significant callus size around the fractures and total weight bearing was allowed (Figure 3).

Figure 3. Radiological aspects of patient's fractures at 30 days after surgery

The child returned to school without social isolation and need for further assistance. 6 months after surgery, all fractures were healed without joint stiffness, muscle hypoplasia and no shortening of the lower limb (Figure 4).

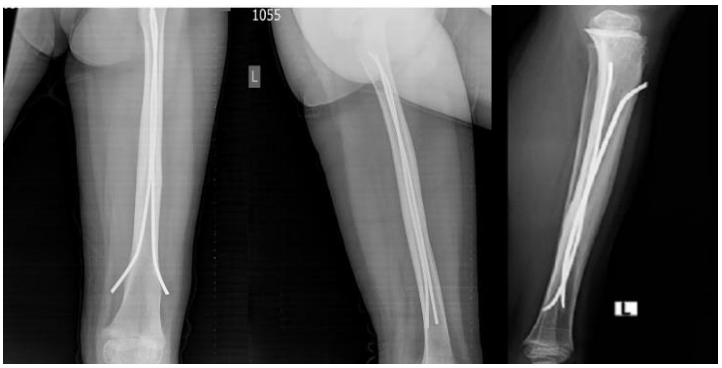

Figure 4. Radiological aspects of patient's fractures at six months after surgery

3. Results and discussions

Although orthopedic treatment has been and remains the gold standard for fractures in children, there are many situations where it cannot be applied. Particularities of growing bone require a different

approach to fracture treatment in children than in adults. The conservative treatment option, based on traction reduction and immobilization, is unanimously accepted [7]. We agree with the concept that has been issued more than 30 years ago, that the best treatment option for shaft fractures in children depends on multiple factors: age, localization of the fracture and its type, surgeon's habit, costs and the technical possibilities of the hospital [8]. Several recent studies comparing conservative and surgical treatment have concluded that noninterventional treatment prolongs hospitalization by an average of three weeks (from one to a four weeks hospital stay) and is a greater source of complications [9,10]. Intramedullary osteosynthesis shortens the hospitalization period and ensures a faster social, educational and mental reintegration of the child in his family friendly environment, compared to the traction treatment and hip spica. For multiple polytrauma fractures in children, the most recommended method remains surgery [11, 12]. Although there are numerous monographs and publications in the literature, in medical practice we encounter atypical or rare fractures for which there is no standardized therapeutic protocol. There are few literature souces to address this atypical pathology [12]. In the last twenty years, fixation of femoral shaft fractures in children with elastic stable nails, placed intramedullary, has become accepted [13]. Titanium, toghether with its alloys, remain the best material for osteosynthesis. Its special properties, such as physical resistance and high anti-corrosion capacity, give titanium an important place in the biomedical and surgical field. Titanium presents outstanding biocompatibility properties and proves, in time, a good integration in the bone tissue [14,15]. The elastic properties of the material absorb the inevitable limited movements, thus ensuring the formation of the callus, even when perfect immobilization cannot be ensured. All these characteristics make it an ideal material for osteosynthesis in children. According to our experience, TEN remains the optimal option shaft femoral fractures with displacement with a transverse or short oblique fracture trajectory in children aged over 6. The use of minimally invasive osteosynthesis remains an effective, safe and easily reproducible method for management of pediatric femoral and tibial fractures. It is not time-consuming, with shorter operative time, lesser blood loss and most importantly a physical protective surgical method [16]. Team experience in the vast range of pediatric trauma is essential in choosing the best treatment method under the given conditions as well as the optimum moment. It is essential that in the case of a child with multiple long bone fracture which requires surgery treatment and associated traumatic injuries, surgical intervention should be less aggressive. The problems posed by pediatric treatment are complex and different from those in adulthood [17, 18].

4. Conclusions

We consider that each case should be treated according to particularities and associated lesions, putting the stabilization of vital functions first, then treating the fractures by a method of treatment that will definitely stabilize the fractures, ensure healing and rapid recovery. We can conclude that in the pediatric fracture with surgical treatment indication, minimally invasive treatment with TEN presents many advantages. More importantly, titanium elasticity promotes callus formation by limiting stress shielding. All its characteristics make titanium an ideal material for osteosynthesis in children. We recommended that this surgical approach for the treatment of fractures in children because of less postoperative pain, minimal blood loss, less postoperative complications and the relative short period of time needed for recovery.

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Manuscript received: 6.12.2019