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SELÇUK TIP DERGİSİ

Treatment of School-Age Children with Femoral Shaft Fracture: Spica Casting versus Titanium Elastic Nail Fixation

Okul Çağı Çocuklarda Femur Cisim Kırıklarının Tedavisi: Pelvipedal Alçı yada Titanyum Elastik Çivi Tespiti

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Özet

Femur cisim kırıkları çocuklarda sık görülür ve hastaneye yatırılarak tedavi gerektirir. Okul çağı çocukluk döneminde (5-12 yaş) femur kırıkları elastik kanal içi çiviler ile yada kapalı redüksiyonu takiben pelvipedal alçılar ile tedavi edilebilir. Bu çalışmada, elastik kanal içi çivileme veya kapalı redüksiyonu takiben pelvipedal alçı ile tedavi sonuçlarının karşılaştırılması amaçlanmıştır. Femur cisim kırığı oluşumu sonrası, hemen kapalı redüksiyon ve pelvipedal alçı yapılan (KR-PPA; Grup 1, n=31) veya elastik kanal içi çivileme (EKİÇ; Grup 2, n=31) yapılan vakalar değerlendirildi. Yaş, cinsiyet, kırık oluşum mekanizması, kırık lokalizasyonu, tedavi maliyetleri, hastanede kalış süresi, radyolojik ve klinik kaynama, yumuşak dokuların durumu, destekli veya desteksiz yürüme zamanları kaydedilerek değerlendirmeye alındı. Ortalama takip 58 (26-62) aydı. Tüm hastaların kırıkları kaynadı. Yük vererek yürüme Grup 2'de (39/52 gün), Grup 1'den (52/63 gün) daha kısaydı. Maliyetler açısından; Grup 1, Grup 2'den daha düşük maliyete sahipti (sırasıyla; 114.99$ ve 380.82$). KR-PPA halen geniş ve kabul edilebilir bir uygulama alanına sahip olsa da, modern cerrahi teknikler ve cerrahi tespit implantları ile daha başarılı sonuçlar alınabilir. EKİÇ ile tedaviler okul çağı çocuk femur kırıklarında daha başarılı tedavi seçeneği sunmaktadır.

Anahtar kelimeler: Titanium elastik çivi, pelvipedal alçı, femur cisim kırığı, okul çağı çocukluk

Abstract

Femoral shaft fractures are mostly seen in children and all cases of this condition require hospital admission. In school-age children (5 to 12 years), femoral fractures may be treated with elastic nails or spica cast. The current study aims to compare the outcomes of elastic nail to the immediate spica cast method for school-age children with femoral fracture. We evaluated the patients who had undergone immediate hip spica cast (IHSC as Group 1; n=31) or flexible intramedullary titanium nail (FITN as Group 2; n=31) for femoral fracture. Age, sex, cause of fracture, localization of the fracture, cost of treatment, times of hospitalization, radiologic and clinical assessment of femoral union, condition of the wound and soft tissue, times of union and walking were recorded. The mean follow-up was 58 (26-62) months. All fractures were healed. The time for weight-bearing and walking were shorter (39/52) in Group 2 than it was in Group 1 (52/63). In terms of cost, IHSC (114.99$) was cheaper than FITN (380.82$). Although IHSC is still a a widely accepted method of treatment, with the use of modern surgical techniques and implants, satisfactory outcomes of fracture healing can make FITN a better surgical option among all other treatments.

Key words: Titanium elastic nail, immediate spica cast, femoral shaft fractures, school-age children

INTRODUCTION

Femoral shaft fractures are mostly seen in children and all cases require hospital admission. Therefore, these fractures raise some difficulties such as surgical or non-surgical treatments, duration of hospitalization, cost, socioeconomic and nursing problems for families.

Conservative treatment of femur fractures is responded well in childhood (1). Despite the fact that treatment of femoral fractures in children depends on age, weight, fracture condition (open/close or simple/communited) in children, it is recently seen that the method of treatment has shifted to more surgical options (2). Almost all cases of femoral shaft fracture in children older than 5 years are treated with flexible intramedullary nailing. However, treatment choices for children aged between 6 and 12 years are open to discussion. For this age group, we have many treatment options such as closed reduction and spica cast, plate fixation, intramedullary nailing (rigid or flexible) and external fixation (3). Although titanium elastic nail (TEN) has certain superiorities to spica cast, TEN has several disadvantages related to cost, complications, secondary operation for implant removal (4,5).

In this study, we aimed to compare the results of TEN and spica cast especially in terms of cost and effectiveness. Does spica casting still offer an effective and cheaper treatment than titanium elastic nailing in school-age children with femoral shaft fracture?

MATERIALS AND METHODS

An institutional ethical committee clearance was obtained. Retrospective evaluation was made for patients between 5 and 12 years who were treated for femoral shaft fracture either with TEN fixation or spica casting between January 2009 and December 2012. Children

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with metabolic bone disease, pathologic fracture or neuromuscular disease were not included in the study. Except intramedullary titanium elastic nailing and closed reduction and immediate cast immobilization, all surgical treatments such as external fixator, plate and screw fixation were excluded. The inclusion criteria for the current study were (a) traumatic diaphysial femoral fracture in the age group of 5 to 15 years; (b) displaced fracture with or without communition; (c) multiple fracture and fractures in patients with polytrauma.

According to treatment, all patients with femoral fracture were divided into two groups –immediate hip spica casting (IHSC, Group 1) and flexible titanium intramedullary nailing (FITN, Group 2). Group 1, under operating theatre conditions and general anesthesia, the fracture was closed reduced as inspected by fluoroscopy on the same day or next day of application to hospital. While traction was applied on fracture limb, keeping the reduced position of the fracture, the hip spica cast was applied in the position in which hip flexed by 30 to 45 degrees and abducted 30 degrees with semiflexion of the knee while ankle is in neutral position. On the unaffected side, the cast was not implemented to the knee and ankle to ensure free movement of these joints. In order to ensure an acceptable reduction, flouroscopic and radiologic checks after hip spica casting were made as suggested by Kasser et al. (6). The next day patients were discharged. The patients were radiological and clinically evaluated in the outpatient clinic once a week until union was achieved. In the 6th week, if we saw bridging callus at three cortices, the hip spica cast was removed and patient was allowed weight-bearing as much as he or she could tolerate. If fracture union was not satisfactory in the 6th week, the cast was kept until it became more consolidated.

In the Group 2, titanium elastic nail fixation was performed in the standard manner (7). The implant diameter was selected to be one-third or 40% of narrowest diameter of the femoral diaphysis. Using distal medial and lateral mini incision, the distal femur was exposed. After closing the reduction of the fracture, FITNs were placed in retrograde fashion. All except one fracture could be reduced in closed manner. Open reduction was necessary for an unreducible fracture with soft tissue interposition. In the postoperative period, we used cefozolin sodium for the first 24 hours. The operated limb was immobilized in a splint. Sutures and splint were removed after 2 weeks and knee, hip and ankle exercise were started.

Age, sex, cause of fracture, localization of the fracture, cost of procedures, time of hospitalization, radiologic and clinical assessment of femoral union, wound and soft tissue healing, times of union and walking were recorded. All data were analyzed using SPSS Windows version 16.0. Mann-Whitney, Chi-square and independent sample t test were used and a value of $p<0.05$ was considered statistically significant.

RESULTS

In the mentioned time, 72 patients with femoral shaft fracture were referred to our clinic. Nine of these patients were excluded due to other treatment options required such as open reduction and plate fixation and external fixation. In Group 1, fracture healing was satisfactory in all cases except one. One patient was reoperated by open reduction and plate fixation due to serious malalignment and this patient was excluded the study. Although the average degree of fracture union in Group 1 was higher than Group 2, all unions were acceptable according to Kasser et al. (6) who described acceptable values of fracture healing in children.

A total of 62 patients were included in this study and divided into two groups as Group 1 and Group 2. All fractures were closed fractures and no accompanied fracture. Full union was achieved in all cases (Figures 1 and 2). Age, sex, the injury type, localization of the fracture of groups are listed in Table 1.

The mean hospitalization was 4 days in Group 2 and 3.38 days in Group 1. These difference is not statistically significant (p=0.67). In Group 2, the mean time to walk with crutches was 39 days while it was 52 days for independent walking. These were 52 and 63 days respectively for Group 1. In terms of time to walk there is no statistically difference between two groups (p=0.65 and p=0.55). Varus, procurvatum degrees and limp length discrepancy were statistically significant between two groups. These were 3.27° and 0.68° ($p<0.003$), 11.33° and 0.71° ($p<0.0001$), 1.2 cm and 1 cm ($p<0.024$) in Group 1 and in Group 2, respectively. The cost of procedures were also evaluated Group 1 was found to be cost effective than Group 2 ($114.99 versus $380.82; Table 2). Four patients had skin irritation because of the entry point of titanium elastic nails. Only one patient in Group 2 had bilateral femoral fracture. All other patients had no accompanying injury. All patients were followed up to 58 (26-62) months.

DISCUSSION

With advanced techniques and implant technologies, surgical treatment options are used more frequently. While school aged children with femoral fractures were treated with spica casting, these fractures are recently treated more frequently by surgical means. Nevertheless, conservative methods are generally preferred for patients of this age group. According to the fundamental rules of treatment of pediatric femoral fractures described by Dameron and Thompson (8). The simplest treatment is the best choice and perfect anatomic reduction is not essential for perfect function. For this reason, early spica casting yields good clinic result and a low rate of complication. If there is no accompanying injury such as abdominal and chest trauma, immediate hip spica casting may be administered in emergency room without

Tablo 1. *Demographic profile of patients and fracture properties.*

	IHSC (n=31)	FITN (n=31)	p value
Age	5-9 (5.67)	5-10 (6.03)	p=0.566*
Sex	10 F/ 22 M	4 F /27 M	p=0,08
Cause of the fracture			
Falling from height	22	2	p<0.0001**
Bicycle accident	3	6	p<0.0001**
Motor vehicle accident	6	23	p<0.0001**
Fracture location			
Proximal	11	13	p=0.063**
Mid	19	16	p=0.060**
Distal	1	2	p=0.271**

* (Mann-Whitney test), ** (Chi-square),

Tablo 2. *Outcomes of two groups.*

	IHSC (n=31)	FITN (n=31)	p value
Hospital stay (days)	4	3.38	p=0.246*** (t test)
Skin irritation	No	4	
Misalignment (degree)			
Varus	3.27	0.68	p=0.003*
Valgus	1.17	0.32	p=0.197*
Procurvatum	11.33	0.71	p<0.0001*
Recurvatum	0.20	0.32	p=1*
Malrotation	No	No	
LLD (cm)	1.2	1	p=0.024**
Walking with support (days)	52	39	p=0,65**
Walking independently	63	52	p=0.55**
Cost (US dollars)	114.99$	380.82$	p<0.0001*

LLD: Limb Length Discrepancy,*Mann-Whitney test, **chi-square, ***t test,

anesthesia (9). This treatment can be applied in operating room, as well. Therefore, there is no significant difference between these two options in terms of clinical results other than cheaper costs associated with emergency administration (10). In this study, all cases in the IHSC group were treated in operating room within the first 24 hours.

Spica casting has some disadvantages for the patient and parents, such as difficult skin care, hygiene, almost total immobilization, as well as educational and social isolation. Also caregivers of these patients have some difficulties taking the patients somewhere in their house or to the hospital, and the patients may suffer from social isolation, and even lose their job (11). On the other hand, simplest treatment does not involve use of implants, implant removal surgery, anesthesia for cast removal, and offers a lower cost than surgical options in addition to the low rate of complications, which is another advantage of the spica cast treatment (12).

Titanium elastic nailing is the most appropriate and least damaging surgical option for treatment of femoral fracture with school-age children as its minimally invasive nature is more biological and gives stable fixation (7). In Group 2, we administered leg casting for two weeks after the surgery. Suture and cast were removed at the end of two weeks, and a range of motion exercises started. When fracture healing was achieved, patients were allowed walking with or without support. Trough, patients were independently ambulated and made their individual care.
Although Group 2 demonstrated better results than Group 1 in terms of misalignment, all angular measurements were acceptable after union. In the literature, titanium elastic nail surgery is shown to have various complication such as prominent nails, soft tissue infection, osteomyelitis, loss of fracture alignment, malunion, nonunion (13,14). We also found four skin irritation on the entry side of the nails. These four patients did not require any additional intervention. No other complications with elastic nailing application were seen in our case series.

Duration of hospital stay was expected to be higher in Group 1 than it is in Group 2. However, we found that it was similar for the two groups. Although duration of hospital stay is known to be a factor that increases the cost, in this study cost differences were attributable to implants and casts. The mean cost was $380.82 in Group 2, which does not include the second operation for the implant removal surgery. On the other hand, the mean cost was $114.99 in Group 1. Therefore, IHSC seems to have a great advantage than FITN. However, in the literature some studies demonstrated that economic and social burden of the IHSC was very higher than FITN according to both patients and their caregivers. (11,15).

In conclusion, treatment of school aged children with femoral fracture remain controversial. Although IHSC is still a widely accepted method of treatment, with the use of modern surgical techniques and implants, satisfactory outcomes of fracture healing can make FITN a better surgical option among all other treatments.

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Figure 1. *Example in Group 1, pre-application (a), close reduction and spica casting (b) and after cast removal (c)*

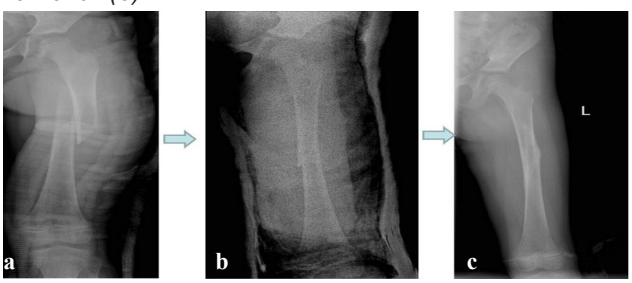
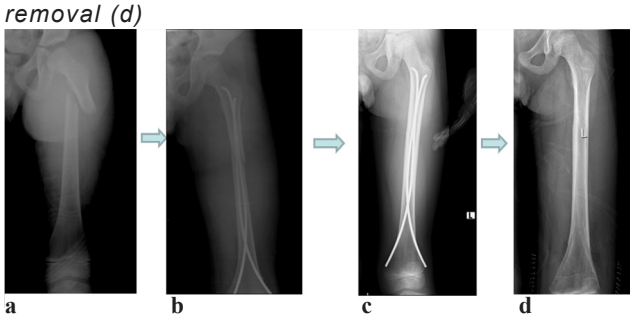


Figure 2. *Example in Group 2, preop (a), postop Day 1 (b), postop. 6th month (c) and after FITN removal (d)*



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