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THE MANAGEMENT OF PEDIATRIC FEMUR FRACTURES – CURRENT TREATMENT OPTIONS AND OUR EXPERIENCES

SUMMARY

Femur fractures are the most common major skeletal injury in pediatric population. These fractures typically occur either in early childhood or during adolescence. The majority of these fractures in children heal satisfactorily regardless of treatment method. Spica casting, or traction followed by spica casting, has been used with great success but in the past decade more aggressive approach such as internal and external fixation has been developed to reduce treatment costs and adverse effects of prolonged immobilization. Decision making is based on consideration of age, sex, fracture location and pattern, understanding of remodelation potential and socioeconomic characteristics of the child and his or her family.

In the four-year-period 75 children (77 femora) aged 6 months to 15 years were treated with different methods for femoral fractures. Sixty-six children (68 femora) met the inclusion criteria. Spica casting (31), traction followed by spica casting (4), open reduction and compression plating (12), external fixation with Mitkovic M.20 fixator (20) and IM nailing (1) were the treatment methods.

Each method has its clear advantages and disadvantages. On the basis of the results of our investigation and review of the literature we developed following treatment recommendations: children younger than 6 years can be satisfactorily treated with immediate closed reduction and spica casting. If the initial displacement is greater than 2cm or the telescoping test is positive a period of traction is recommended. In older children with long spiral or comminuted fractures with large free fragment as well as in polytraumatised children external fixation is the treatment of choice. In older children with displaced transverse or short oblique fractures and in children with severe head trauma compression plating is a better treatment option. Rigid intramedullary nailing should be abandoned due to high risk of avascular necrosis. Elastic intramedullary nailing with titanium or Ender nails should be considered as the best treatment method but the expenses and lower axial and rotation stability represent its major disadvantages. Minimally invasive percutaneous plating and internal fixator are the methods that should be evaluated in the future as potential options for treating femoral fractures in children.

Key words: **femoral fractures, children, external fixation, compression plating, closed reduction**

INTRODUCTION

Femur fractures are the most common major injury treated by pediatric orthopedists (1,2). These fractures typically occur either in early childhood, due to changes in bone structure, or during adolescence, when children are exposed to high-energy traumas in sport and motor vehicle accidents (3).

The majority of femur fractures in children heal without any long-term sequelae regardless of the treatment method. Spica casting, or traction followed by spica casting, has been used with great

success in children, because of their enormous ability to remodel possible deformities after closed treatment (2,4,5).

In the past, operative treatment has been reserved for children with polytraumas, "floating knee" injury children with metabolic bone disease and for femur fractures in adolescents.

Recently, increasing attention has been focused on health care cost reduction and the elimination of negative social, physical, and emotional effects of prolonged immobilization.

All these considerations have generated the enthusiasm to a search for better ways to treat femur fractures in school-age children, such as internal and external fixation, despite the fact that the combination of traction and cast immobilization yields good results.

Decision making is based on consideration of several factors. Understanding the remodelation potential after fracture union is the first. Generally, this potential is maximal in children below 6 years of age, it decreases with age and is minimal in adolescents. Acceptable fracture alignment at the union site in children who are two to ten years old is up to 15° of varus or valgus angulation, up to 20° of anterior or posterior angulation, up to 30° of malrotation and shortening at union no more than 1.5 to 2.0 cm. In older children, minimal angulation and malrotation and no more than 1.0 cm of shortening are recommended. In addition to remodeling, fracture pattern, stability, and location of the fracture are important factors when deciding on the suitability of certain treatment options. After consideration of all of these factors and the socioeconomic characteristics of the child and family as well, the surgeon can discuss possible treatment options, taking into account the risks and benefits of each of them (1,2).

Current treatment options:

1. Spica casting with or without preliminary traction is a simple, effective and noninvasive method for treating femoral fractures in children less than 6 years old. Children with initial shortening of more than 2 cm, or telescoping of more than 2.5 cm require traction until visible callus is formed. Over-head skin traction is suitable for children less than 20 kg, and vertical transossal 90°–90° traction for others. One-and-a-half hip spica cast can be applied either with the mild hip and knee flexion or in "seating" position with 90° of hip and knee flexion. These methods are difficult to use in patients with other major injuries, a floating knee injury or severe soft tissue damage and metabolic bone diseases. Cast pressure sores, loss of reduction requiring remanipulation and leg length inequality are some well known complications.

2. External fixation is an excellent method for restoring the length and alignment without long incisions, exposure of the fracture site and major blood loss. The application is relatively quick. The most popular unilateral frames are Orthofix, AO and Mitkovic M.20. External fixation is especially suitable for open fractures or fractures associated with severe soft-tissue injury, children with multiple trauma or head injury, or some fracture patterns such as comminuted or long spiral fractures and vary proximal or distal fractures. It can be applied simultaneously with other surgical procedures in polytraumatised children, preferably on the fracture table where most of the displacement can be corrected prior to the fixator application. The most distal and proximal pins are placed first. Placing two central pins more distally from the fracture site and closer to the other two pins will reduce the frame stiffness thus preventing the stress-shielding of the fracture. Weight-bearing is allowed as tolerated. Once the callus is visible, the frame can be dinamised. When bridging callus on the 3 cortices is sufficient, the fixator is removed and walk in protective brace is encouraged. Very proximal or distal fractures may preclude proper pin placement. A relative contraindication to the use of external fixation is a family or social environment that cannot support compliance with pin care, precautions, and follow-up. Reported complications encountered are pin site irritation, pin tract infections, deep wound infections refractures and unsightly scars.

3. Open reduction and plate fixation is an effective treatment method for pediatric femoral fractures. Advantages include anatomic alignment and rigid fixation that allows rapid mobilization, the familiarity of the technique and widely available equipment. However, the large incision, greater blood loss, refractures, hardware failure and necessity of hardware removal limit the indications. The indications include very proximal or distal fractures, for which there is no other treatment that would allow rapid mobilization, multiple injuries in a child less than twelve years old, a child needing concomitant repair of the femoral artery and a child in whom the fracture pattern is not suitable for elastic intramedulary nailing and whose socioeconomic background precludes external fixation. The use of 4.5-mm dynamic compression plates is recommended, with fixation of at least six cortices on each side of the fracture. Newer recommendations for plate include the use of longer plates and fewer screws, and indirect reduction with less soft-tissue stripping. The newest concept is minimally invasive percutaneous plating. A similar concept utilizing the advantages of plate fixation and external fixators and eliminating disadvantages of both is the internal fixator Mitkovic.

4. Flexible intramedulary nail fixation maintains length and alignment but permits sufficient motion at the fracture site to generate excellent callus formation. Because this method allows rapid mobilization of children with little risk of avascular necrosis, physeal injury, or refracture, it has become the treatment of choice for children over 6 years of age with transverse fractures in the middle 60% of the femur. Although both Ender nails and titanium elastic nails provide flexible intramedullary fixation, the techniques and implants have important differences. Stainless steel Ender nails are stiffer, and the stability is achieved by bent of the nail and "canal fill". Elastic titanium nails involve balancing forces of two opposing implants. The procedure is best performed on fracture table, obtaining reduction of the fractures first. Nails are inserted about 2.5 cm proximal to the distal femoral physis through the 3 cm long medial and lateral incisions. Both nails are advanced to the fracture site and the nail that will improve reduction is advanced first. Nails are advanced to the level of the greater trochanter, and cut that only for about 1 – 1.5 cm lies in the soft tissues. Immobilization depends on the fracture pattern. Weight bearing is allowed as tolerated. Elastic intramedullary nailing may not provide sufficient stability in comminuted, long spiral fractures and in vary proximal or distal fractures. The most reported complication is soft tissue irritation by the extraosseous part of the nail.

5. Rigid anterograde intramedullary nail fixation offers maximum stability and load-sharing. As in adults, it is the treatment of choice for displaced femoral shaft fractures in skeletally mature adolescents. Due to high risk of avascular necrosis of the femoral head even in the cases were "proper lateral technique" was used, it is not recommended for skeletally immature adolescents.

MATERIAL AND METHODS

A retrospective analysis of medical records of children treated for femoral fractures between December 1999 and December 2003 was conducted in our institution.

Injury, treatment and follow up data were collected from the hospital chart. Injury data included patients' sex, age at injury, fracture site and location, weather the fracture was open or closed and types of associated injuries. Method of treatment, specific hardware used, time to healing and cast or hardware removal limb length inequality (LLI) and complications were recorded. Time of healing was determinate by the treating surgeon on the clinical and radiographic examination. LLI was measured on one--year follow up.

Seventy-five children with 77 femora were identified. Patients under age of 15 with at least one year follow-up and complete set of radiographs were included in the study. Four patients with femoral neck fractures (2 girls and 2 boys) and 2 boys with distal femoral physeal fracture were excluded. Two patients were excluded due to shorter follow-up period and one because incomplete documentation.

Closed reduction and casting was performed under general anesthesia on the fracture or casting table, under fluoroscopic control. Radiographic controls were performed in the 7 to 10 day interval until fracture healing. Skeletal traction if necessary was performed in usual fashion for 90°-90° transcondylar skeletal traction.

External fixator was applied on the fracture table, as an independent procedure or simultaneously with other surgical procedures. Mitkovic M. 20 fixator was used in all cases. Convergent four pin configuration was utilized. Pins were inserted at least 2 cm from the physis and from the fracture site. In several cases where closed reduction could not be obtained due to muscle entrapment small lateral incision was performed to facilitate reduction. Pin site care was performed on the second day. Weight bearing is allowed as tolerated. Frame is dynamised if necessary when callous becomes visible. Hardware removal was performed under sedation or general anesthesia depends on age when three cortexes bridging callous become visible. After fixator removal protective bracing was continued for about 2 months.

For open reduction of the fractures lateral approach was used. Plates were chosen depending on the fracture pattern. At least 4 cortices on each fracture site were fixed. Wound is closed with intradermal nonabsorbale sutures. All fractures were immobilized in the 1 and 1½ hip spica cast but period of immobilization varies with age of patients. In older patients cast was changed to brace in the third postoperative week and partial weight bearing on crutches was allowed. Plates were removed after minimally 8 months. Protective walk on crutches for 10 to 15 days after plate removal was advised.

RESULTS

Seventy-five children with femoral fractures were identified. Inclusion criteria was met by 66 patients (68 femurs) and they were included in the study. Follow up period was 12 to 51 months, mean 31 month. Fifty patients were boys (76%) and 16 were girls (24%). Thirty-six fractures were on the

left (55%) and 28 on the right side (42%), and 2 patients had bilateral fractures (3%) Fracture location included 2 subtrochanteric (2.9%), 61 in the midshaft (89.7%), and 5 distal femoral and supracondylar fractures (7.5%). There were 61 closed fractures (89%) and 7 open (11%). One open fracture was Gustillo grade I and other 6 were Gustillo grade II open fractures. These were treated with immediate irrigation and debridement and fixation. Forty-three patients had isolated fractures (65%) and 23 had multiple injuries (35%). Associated injuries are listed in table 1. None of the patients with isolated femoral fractures was haemodynamically unstable requiring blood transfusion. Some patients with associated injuries received blood transfusions because of other injuries.

Table 1. Associated injuries

Type of associated injury		(N=) Total	
Craniocerebral	Fractures Contusions Commotions	4 5 3	12
Abdominal	Spleen lacerations Hepatic contusion Renal contusion	3 1 1	5
Thoracic	Haemothorax	1	1
Soft tissue	Lacerations	6	6
Fractures	Pelvis Crusis Forearm Clavicle	2 4 3 2	11

Thirty-one femurs were treated with closed reduction and immediate spica cast (46%); four patients were treated with skeletal transcondylar traction for a period of 16 to 27 days prior to application of cast (6%). External fixator was applied on 20 femora (29%). In 12 cases open reduction and compression plating was performed (18%) and in one case the fracture was stabilized with rigid intramedullary Kuntcher nail (1%) (figure 1). The average age varies in different treatment groups, and is shown in figure 2.

Results and complications of treatment are summarized in table 2.

Mean duration of the hospital stay is shown on figure 3. In children with other severe injuries duration of hospital stay never depended on femoral fracture but on the other injuries.

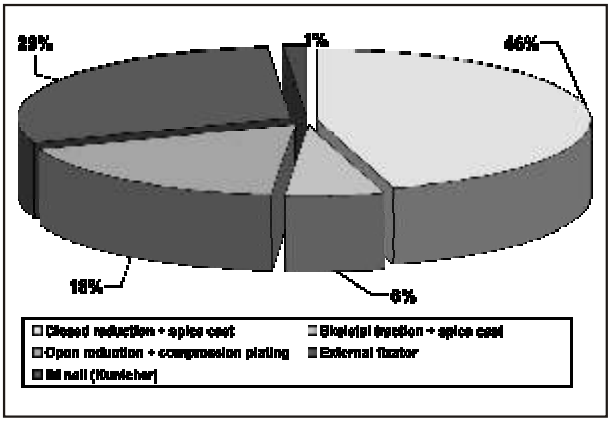

Figure 1. Different treatment options for pediatric femoral fractures

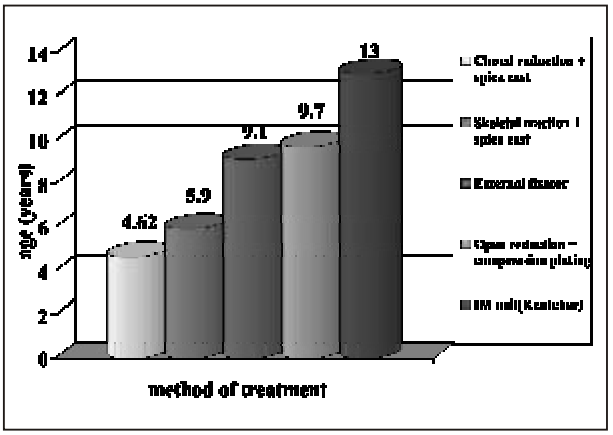

Figure 2. Mean age of patients in different treatment groups

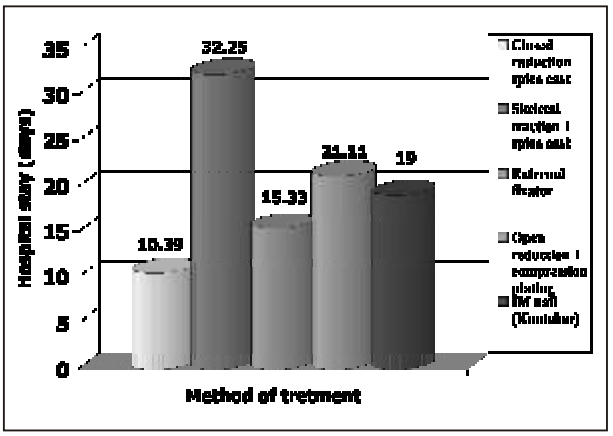

Figure 3. Mean duration of hospital stay in different treatment methods

Thirty-one children were treated with early casting (figure 4). In 7 secondary displacements requiring remanipulation had occurred. Time to union varied from 4 to 9 weeks. One refracture had occurred due to fall. Two fractures healed in varus greater than 10°, and 3 with anterior bowing that exceeded 10°. LLI ranged from -3 to 19 mm.

Four children were treated with a period of traction prior to spica cast. Transcondylar skeletal

Table 2. Results and complications of treatment in different treatment method groups

Method of treatment (n of patients)	Time to union (weeks)	Time to hardware removal (months)	Lower limb inequality (mm)	Refracture	Angulation >10^0 (Varus/Valgus)	Angulation >10^0 (ante/rekurvatum)	Secondary displacement	Skin irritation Superficial infections	Deep infections
Closed reduction + spica cast (31)	4-9	0	-3–19	1	2	3	7	0	0
Skeletal traction+spica cast (4)	5-8	0	-2–14	0	1	1	0	1	0
Open reduction+compresion plating (12)	6-10	8-14	7-17	0	0	0	0	0	0
External fixation (20)	4-15	4-15	-3-+/-23	2	3	2+1	1	3+5	1
IM nail (Kuntcher) (1)	8	13	12	0	0	0	0	0	0

Figure 4A & 4B: Initial radiograph and immediately after closed reduction and cast immobilization (A); 29 nine months post injury (B)

traction was used in all patients, with mean duration of 17 days. Time to union ranged from 5 to 8 weeks. LLI on follow up ranged – 2 to 14 mm. Two fractures healed with angulations greater than 10° (one varus and one posterior bowing). In one patient skin irritation around the pin has occurred.

In twelve children open reduction and compression plating were performed (figure 5). Standard lateral approach was used. After the reduction of the fracture, osteosinthesis with compression plate and screws engaging at least four cortices on each side was performed. Immobilization with hip spica cast was applied in all children. Once the wound healed, spica cast was removed and above hip orthosis was applied. Partial weight bearing on crutches with orthosis was allowed about 6 weeks postoperatively. All fractures healed in anatomic position in 6 to10 weeks. No refractures and angular deformities occurred. No wound problems were encountered. LLI ranged from 7 to 17 mm. Time to hardware removal ranged 8 – 14 months.

Twenty femora (19 patients) were treated with external fixations (figure 6A and 6B). We preferred closed reduction on the fracture table whenever possible. In 4 patients mini incisions over the fracture site to facilitate reduction were performed. Four pins with convergent orientation (30°–60°) were used. In the first 9 patients "inner" two pins were placed as close to the fracture site as possible, but not closer than 2 cm. In the rest of the patients pins were inserted as far from the fracture site as possible to reduce stiffness of the frame. Pins were placed at least 2 cm away from physis. Range of motion exercises were started as tolerated, usually on the second postoperative day. None weight bearing on crutches was encouraged. Once callus was visible, weight bearing as tolerated was allowed. When three bridging cortices were visible on radiograms, the fixator was removed. Time to fixator removal ranged 4–15 weeks. Protective orthosis was applied on the surgeons'

Figure 5. Injury film; six weeks after compression plating; and 12 months after operation in time of plate removal

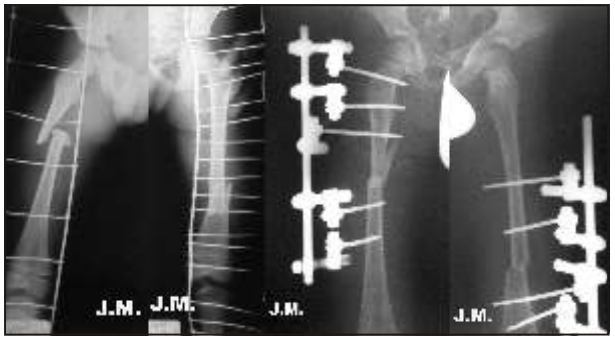

Figure 6A & 6B. Six -year-old boy with bilateral femur fractures sustained in road accident. Both femurs were reduced on fracture table and externally fixed (A). At four-year follow up both fractures healed (B).

preferences. Routine pin site care was performed on the second day. Skin irritation appeared in 3 patients. Five patients had superficial pin tract infections treated with oral antibiotics and daily pin site care. In one girl deep infection developed due to neglect in the family with severe mental illness. After debridement, double drainage and intravenous antibiotics were administered. She was placed on transossal traction and her fracture healed in satisfactory position. One patient with head injury loosened fixation clamp which leaded to secondary displacement of fracture. This was treated with remanipulation and adding one pin in the proximal fragment. In two cases refracture occurred in both after premature fixator removal (only two bridging cortices were visible).On the follow up LLI ranged -3 - +/-23 mm. The greatest LLI was measured in the boy with bilateral femoral fracture so it can be attributed neither to overgrowth nor to shortening. Three femora healed in varus greater than 100. In one adolescent plastic deformation had occurred after earlier removal of fixator. Anterior bowing of more than 100 was present in 2 and posterior bowing in 1 patient on the final follow up.

One thirteen years old girl was treated with intramedullary nailing with Kuntcher nail in the beginning of the study period. Her fracture healed in 8 weeks and after 13 months the nail was removed. Overgrowth was 12 mm. She was the last patient treated with rigid IM nailing and this method is not currently used in our institution.

DISCUSSION

Fracture of the femur, either isolated or as an element of polytraumas, represents the most common serious skeletal injury in children. It was traditionally treated conservatively with spica casting, with or without traction, relying on the great remodelation potential in children.

In the last decade, more aggressive treatment options were instituted primarily to reduce the treatment costs and adverse effects of prolonged immobilization.

Berne et al. (4) reported the series of 47 children less than 7 years old treated with early hip spica casting with good results. Rybka et al. (6) reported the series of 335 children treated with Weber's or Bryant's traction over 22-year period. They concluded that well established methods should not be abandoned easily. Although the children treated by these methods are confined to bed for a longer period than when more recent techniques are used, they may avoid many of the complications that accompany these new approaches.

Weinberg et al. (7) published the series of 121 children with femur fractures treated with external fixation with the refracture rate of 5.8%; superficial infections in 7.4%: technical problems in 4.1% and 14% of angular deformities.

Kesemenli et al. (8) reported the series of 192 pediatric femur fractures and compared the results of conservative treatment (100 patients) and external fixation (92 patients). Refracture rate was 1.8% in patients treated with closed reduction and 20% in patients treated with open reduction. They concluded that fracture haemathoma emptying in open reduction is a predisposing factor to refracture.

Hedin et al. (9,10) reported the results of treatment of 98 children with femur fractures 3 to 15 years old over 8 years' period at two hospitals. Pin tract infection occurred in 18% of cases. Only 2% of refractures and 3% of angular deformities were reported. LLI was less than 1 cm in all but one case. They recommended this treatment option for all children >20 Kg which are too heavy for skin traction.

Mostafa et al. (11) reported the results in the series of 46 children treated with AO dynamic compression plate. All fractures healed in an average of 8 weeks. One hardware failure and one superficial infection were all complications. Limb length inequality ranged 0.5 – 1.5 cm.

Caird et al. (12) reported the series of 60 children treated with AO dynamic compression plate. Overall complication rate was 10% (2 refractures, 2 symptomatic LLI, 1 hardware failure and 1 hyperthrophic scar).

Flynn et al. (13), Özdemir et al. (5) and Luhmann et al. (14) reported the results and complications of treatment of femoral fractures in children with ESIN (elastic stable intramedullary nailing). They concluded that ESIN is the treatment of choice for children 6 to 15 years old with femoral fractures, since it is minimally invasive, provides early mobilization and has low complication rates. Its main disadvantage is rotational and axial instability.

In our study, age, sex, side, fracture localization and pattern were similar to other reports (3).

Hip spica casting produced satisfactory results in children younger than 6 years. Secondary displacement requiring remanipulation was the major complication (1). Rate of LLI and angular deformities are comparable to other series (4,6). Main disadvantages of the method are prolonged immobility and need for frequent radiographic controls. In children with marked initial shortening or positive telescope test some sort of traction is required. We used 90°-90° skeletal traction in all children >20 kg and skin traction in the others.

External fixation has definitive advantages in its immediate application, low cost and early mobilization (1,2,7,9,10,15,16). Most of the treatment complications can be avoided. Fracture site should not be opened and fracture haemathoma evacuated (8). Pins should be placed as far from the fracture site as possible (15). That should reduce the risk of refracture. Convergent pin orientation increases stability in all planes. Proper pin site care and release of any skin tent over the pin reduces skin irritation and superficial infections. Timing of fixator removal is essential to avoid refracture and plastic deformation leading to angular deformity. Proper selection of the patient, taking into account social and mental status of the parents or care-givers and severity of head trauma may reduce other complications that we experienced, such as deep infection and hardware failure.

Plate fixation (DCP) is a safe method of treatment with lower complication rate especially in children above 10 – 12 years of age (1,2,11,12). Need for open reduction, potential blood loss and potential postoperative wound infections, as well as the need for another operation for plate removal remain its main disadvantages.

Elastic stable titanium nailing (1,2,5,13,14) is currently the method of choice in the treatment of femur fractures in children 2 – 15 years old in most well developed countries. Cost of the nails is the major disadvantage in low income countries. Other disadvantages are pin irritation of soft tissues and lower rotational and axial stability compared to other methods. We do not have any personal experience with this method.

Other minimally invasive methods such as MIPPO (minimally invasive percutaneous pinning) or the internal fixator which combines the advantages of external fixator and plate fixation was satisfactorily applied in adults. Further studies are necessary to demonstrate its applicability in children.

CONCLUSION

Although conservative management of femoral fractures in children yields good results, more aggressive treatment is necessary to reduce hospitalization, immobilization and costs. Operative methods allowed earlier mobilization and return to school with overall better results than conservative treatment. Psychosocial effects of the prolonged immobilization hospitalization and absence from everyday activities in the adolescents cannot be overemphasized.

There is no universally valid method for femoral fractures. Each method has its own advantages and disadvantages and its role in the treatment of femoral fractures in children.

Closed reduction and hip spica casting remains method of choice for treatment of femoral fractures in children below 6 years of age.

In severely injured children and in polytraumas external fixation should be the method of choice, as well as in children with long spiral or comminuted femoral fractures.

Open reduction and compression plating is the optimal method for very proximal or distal fractures and fractures in children over 10 – 12 years. Compression plating can be more suitable for children with severe head injury than external fixation.

Elastic intramedullary nailing either with Ender nails or titanium nails is the treatment of choice in the USA and Europe for children 6 – 15 years old but we have no experience with those methods. Further investigations and experience with other minimally invasive methods are needed.

REFERENCES

1. Flynn JM. Current treatment options for pediatric femur fractures. In: Penns Orthop Journal 1998;11:27–35.

2. Flynn JM, Skaggs D, Sponseller PD, Ganley TJ, Kay RM, Leitch KK. The operative management of pediatric fractures of the lower extremity. J Bone Joint Surg Am. 2002;84:2288–2300.

3. Hinton RY, Lincoln A, Crockett MM, Sponseller P, Smith G. Fractures of the femoral shaft in children incidence, mechanisms, and sociodemographic risk factors. J Bone Joint Surg Am 1999; 81–A:500–509

4. Berne D, Mary P, Damsin JP, Filipe G. Femoral shaft fracture in children: treatment with early spica cast. Rev Chir Orthop Reparatrice Appar Mot. 2003; 89: 599–604.

5. Özdemir MH, Yensel U, Senaran H, Mutlu M, Kutlu A. Immediate percutaneous intramedullary fixation and functional bracing for the treatment of pediatric femoral shaft fracture. J Pediatr Orthop 2003; 23: 453–457.

6. Rybka D, Trc T, Mrzena V. Conservative treatment of femoral fractures in children In data from the Orthopedic Clinic of the 2nd Medical Faculty of Charles University. Acta Chir Orthop Traumatol Cech 2003; 70:170–6.

7. Weinberg AM, Hasler CC, Leitner A, Lampert C, von Laer L. External fixation of pediatric femoral shaft fractures treatment and results of 121 fractures Eur J Trauma 2000; 26 :25–32

8. Kesemenil CC, Subasi M, Arslan H, Tüzüner T, Necmioglu S, Kapukaya A. Is external fixation in pediatric femoral fractures a risk factor for refracture? J Pediatr Orthop 2004; 24:17–20.

9. Hedin H, Hjorth K, Larsson S, Nilsson S. Radiological outcome after external fixation of 97 femoral shaft fractures in children. Injury 2003; 34:287–292.

10. Hedin H, Hjorth K, Rehnberg L, Larsson S. External fixation of displaced femoral shaft fractures in children: a consecutive study of 98 fractures. J Orthop Trauma 2003;17:250–256

11. Mostafa MM, Hassan MG, Gaballa MA. Treatment of femoral shaft fractures in children and adolescents. J Trauma 2001; 51 :1182–1188.

12. Caird MS, Mueller KA, Puryear A,. Farley FA Compression plating of pediatric femoral shaft fractures. J Pediatr Orthop. 2003;23:448–452.

13. Flynn JM, Hresko T, Reynolds RAK, Blasier RD, Davidson R, Kasser J. Titanium elastic nails for pediatric femur fractures: a multicenter study of early results with analysis of complications. J Pediatr Orthop 2001;21:4–8.

14. Luhmann SJ, Schootman M, Schoenecker PL, Dobbs MB, Gordon JE. Complications of titanium elastic nails for pediatric femoral shaft fractures. J Pediatr Orthop 2003; 23:443–447.

15. Domb BG, Sponseller PD, Ain M, Miller NH. Comparison of dynamic versus static external fixation for pediatric femur fractures. J Pediatr Orthop 2002; 22: 428–430.

16. Jawadi AH, Letts M. Injuries associated with fracture of the femur secondary to motor vehicle accidents in children. Am J Orthop 2003; 32:459–462.

LE^ENJE FRAKTURA FEMURA KOD DECE ‡ SAVREMENE MOGU]NOSTI LE^ENJA I NAŠA ISKUSTVA

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Sa`etak

Fraktura femura je naj~e{}a ozbiljna povreda ko{tanog sistema u de~jem uzrastu.

Ove povrede se naj~e{}e javljaju ili u ranom detinjstvu, ili u adolescenciji. Najve}i broj ovih fraktura zaraste dobro, bez obzira na na~in le~enja.

Gipsana imobilizacija, ili trakcija posle koje sledi gipsana imobilizacija, su dugo bile vrlo uspe{ne metode le~enja. U poslednjoj deceniji je do{lo do razvoja agresivnijeg pristupa, kao {to je unutra{nja i spolja{nja fiksacija, da bi se smanjila cena le~enja i ne`eljeni efekti produ`ene imobilizacije. Dono{enje odluke o na~inu le~enja se zasniva na razmatranju uzrasta, pola, lokalizacije i tipa preloma, poznavanja remodelacionog potencijala i socioekonomskog stanja deteta i njegove porodice.

U ~etvorogodi{njem periodu zbog frakture femura, razli~itim metodama je le~eno sedamdesetpetoro dece (77 femura), uzrasta od 6 meseci do 15 godina. [ezdeset{estoro dece (68 femura) su ispunili kriterijume za uklju~enje u studiju. Metode le~enja su obuhvatale gipsanu imobilizaciju (31), trakcija sa gipsanom imobilizacijom (4), otvorenu repoziciju i kompresivnu osteosintezu plo~om (12), spolja{nju fiksaciju fiksatorom M.20 po Mitkovi}u (20), i intramedularnu osteosintezu (1).

Svaki na~in le~enja ima jasne prednosti i nedostatke. Na osnovu rezultata na{eg ispitivanja i pregleda literature razvili smo slede}e preporuke za le~enje fraktura femurau de~jem uzrastu: deca mla|a od 6 godina mogu se uspe{no le~iti ortopedskom repozicijom i gipsanom imobilizacijom. Ako je inicijalni deplasman fragmenata veæi od 2 cm, ili je test teleskopiranja pozitivan, preporu~uje se period trakcije pre gipsane imobilizacije. Kod starije dece, sa duga~kim spiralnim ili kominutivnim prelomima, sa velikim slobodnim fragmentom, kao i kod politraumatizovane dece, spolja{nja fiksacija je metoda uzbora. Kod starije dece sa dislociranim popre~nim ili kratkim kosim prelomima, kao i kod dece sa te{kim povredama glave, kompresivna plo~a predstavlja bolji izbor. Rigidna intramedularna fiksacija se ne preporu~uje zbog visokog rizika od avaskularne nekroze. Elasti~na intramedularna osteosinteza titanijumskim ili Enderovim klinovima se u svetu smatra najboljim na~inom le~enja, ali su visoka cena i manja aksijalna i rotatorna stabilnost, njeni glavni nedostaci. Minimalno invaziva perkutana osteosinteza plo~om i unutra{nji fiksator su metode ~ija se potencijalna vrednost u le~enju preloma femura kod dece mora razmotriti u budu}nosti.

Klju~ne re~i: frakture femura, deca, spolja{nja fiksacija, kompresivna osteosinteza, zatvorena repozicija