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"Assessment of outcome of early versus delayed spica cast treatment of closed femoral shaft fractures in children"

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Abstract

Background

Femoral shaft fractures occur very frequently in children, almost all unite rapidly, regardless of type or location of fracture and treatment method chosen. Their prognosis is usually good. Nonoperative treatment is the gold standard for children under 8 years because of the excellent bony union and the remodeling qualities [(1)].

Aim of study

The aim of this study is to compare the outcome of two orthopaedic therapeutic methods: immediate reduction and spica cast versus skin traction and delayed spica application.

Materials and methods

This study was performed at Sulaimani Teaching and Casualty Hospital between first of October 2009 and thirties September 2010. The study involved 28 children, divided into two groups:

In group 1, an immediate reduction with early hip spica casting was performed.

In group 2, treatment consists of skin traction for 2-3 week followed by hip spica casting. We studied gender distribution, fracture side and site, fracture type, complications include; initial shortening, axial, sagittal and rotational alignment and the hospitalization duration. All patients were kept under observation for a period of about 3 months after removal of spica cast.

Results

The study revealed that boys were affected more than girls, the middle third of the femoral shaft was the most common site fracture (60.7%), the spiral fracture was the common type the femoral shaft fracture (46.4%) and the side way angulation was recorded more than other types of complications in both treatments modalities; for immediate spica 3 children (16.5%) and in delay spica 2 cases were recorded account for (20%).

Conclusions

There was little significant difference between early and delayed spica regarding the complications of treatment and functional outcome. But immediate spica decreased the hospitalization time and the cost of treatment significantly while having similar result as achieved by delayed spica application.

Keywords: Femoral shaft fractures, Nonoperative treatment, spica application.

Introduction

Femoral shaft fractures represent the third most common location of children's fractures, after those of the upper limbs. Usually caused by major violence, so associated injuries are common, their prognosis is good due to the growth potential [(1)].

The femoral shaft is surrounded by powerful muscles, which cause severe displacement of femoral shaft fractures by these muscles pull and this requires powerful traction for their correction[(2)].

Generally, non-operative treatment is an effective method of treatment for closed femoral shaft fracture in children. Spica cast may be applied early or delayed if applied after a period of traction and observation by x-ray.

Non operative treatment is the gold standard for children under 8 years because of the excellent bone union and the remodeling qualities. However, the main complication of femoral shaft fracture is the limb length discrepancy resulting from the overgrowth of the broken limb. This problem is reported by many authors whichever non operative treatment is used and must be taken into account when choosing the therapeutic method [(3)].

Aim of study

This study will assess the outcome between immediate spica application and delayed spica after period of traction in children presented with femoral shaft fracture.

Patients and Methods

This study was performed at Sulaimani Teaching and Casualty Hospitals during the period between first of October 2009 and thirties of September 2010.

28 Patients with closed femoral shaft fracture were included in our study divided in to two groups; the **first group** includes 18 patients treated by immediate spica application and the **second group** involve 10 patients were treated by period of traction then delay spica application. These patients were followed for period of four months.

All these patients were admitted to our hospital and in every case we looked for the following: Name, age, sex, address, date of injury, mechanism of injury, side of fracture, type and site of fracture.

We excluded from this study the patients presented with: compound femoral shaft fracture, multiple fractures, sever associated injures and cerebral palsy.

Management

General examination was considered to exclude any associated injuries e.g. head, chest, abdomen, pelvic injuries that take apriority in the management and emergency treatment was given with special attention to the cardiopulmonary status, abdomen, and central nervous system. The strategy was to admit all children to hospital for reduction of fracture under general anesthesia, to allow a short period of observation for other injuries and provides time for parents to be instructed to take care of their child in spica.

The neurovascular component of the injured limb were then carefully assessed and compared to the contra lateral side.

Skin traction was then applied to the injured limb in the emergency unit; the patient was then admitted to the orthopedic wards after a general reassessment.

Anteroposterior and lateral views X-rays of the injured thigh were then taken as well as x-rays of pelvis and ipsilateral knee.

Type of specific treatment:

All patients treated by spica cast provided that they had no other associated injuries, they were managed by either immediate reduction and spica cast application or delayed spica application. The decision was taken randomly.

First group (early spica cast):

18 patients were treated by this method, their age range between (2-8) years. Immediate spica cast was done in the first 24 hours after admission to the hospital.

Initial procedures:

When the child is first seen, analgesia is given and standard radiographs are obtained skin traction is used until the spica can be applied, or when the child has fully recovered from such complications as mild head or abdominal injury.

Technique of reduction and cast application:

The technique of manipulative reduction and cast application are straight forward but attention to details is necessary.

The procedure was performed under general anesthesia. We applied a smoothly padded long leg cast to the injured extremity, while the assistant maintains slight traction with the knee flexed about 20 degrees. The cast must be carefully molded in the supracondylar area so that traction can be applied to the extremity without cast slippage.

The leg cast is permitted to set and then we moved the child to the casting table; now applies a light traction to the cast and uses the cast as a handle to position the fracture fragments. The cast controls varus-valgus and anteroposterior angulations as well as rotation. Judgment in position comes with experience. For fracture below the proximal third of the diaphysis; holding the cast with the hip flexed for about 30 degrees, abducted about 30 degrees, and externally rotated about 15 degrees generally provides an acceptable reduction. While if the fracture is in the proximal third more hip flexion to 45 degrees may be needed [(19)]. We hold the reduction while the assistant completes the cast to a full double spica.

We put the knee flexed at 15-30 degrees, and confirmed reduction with image intensifier. We accepted up to 20 mm of shortening, 20 degree of anterior angulations, and 15 degrees of valgus angulations but no posterior nor varus angulations [(19)]. Rotation is judged clinically, the foot should be in slight lateral rotation. Correct rotation is achieved by placing the foot in a slightly out-turned position, with an additional 10 degrees lateral rotation, any unacceptable angulations can be corrected by wedging the spica and plastered it again.

Second group (Delayed spica after traction):

10 patients were treated by this method, their age ranged between (2-8) years. We continue on skin traction with daily observation of our traction and weekly X-ray examination.

After 2-3 weeks when the fracture feels sticky and slight callus appear on the X-ray a hip spica was done under short general anesthesia. Radiological examination was done after spica application to check the fracture alignment then every two weeks until fracture union occur.

After-care (for both groups):

The child is allowed to return home when fit, usually the following day. The parents are shown how to care for the child. The child reviewed 1 week after discharge. If radiographs are satisfactory then the child is reviewed 3-4 weeks for those treated by delay spica and 4-6 weeks later for children treated by early spica for removal of plaster. We removed the spica when there were clinical and radiological signs of union usually after 4-8 weeks. After removal of spica, all these patients were carefully examined for status of walking, length discrepancy, deformity and angulations. We applied some sort of splint to the fractured limb after removal of the spica in form of hip-knee orthosis for another 2 weeks and all these patients were followed every month for a period of three to four months to check for any deformity, length discrepancy or other complications.

Statistical analysis

Results are expressed as mean and range values. Comparisons of quantitative parameters between the two patient groups were done with the aid of statistical package for the social sciences (SPSS version 16) data base program. *P* value below 0.05 is considered to indicate statistical significance.

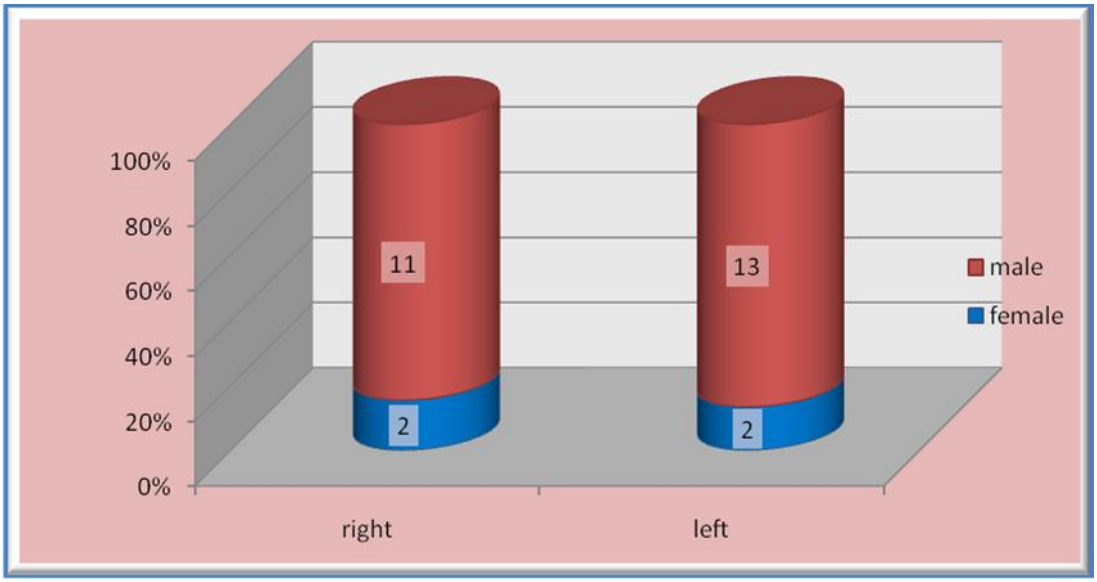
Results

Twenty-eight patients were followed for a period of three to four months. Age ranged from two to eight years, the mean age for early spica was (4.34) years and for delayed spica was (5.95) years. The gender distribution of the patients was 4(14.3%) females and 24(85.7%) males.

15(53.5%) cases were left sided fractures while right side fractures were in 13(46.5%) patients only.

Table (1) the side of fracture & sex distribution.

Side	Male	Female	Total
Left	13	2	15
Right	11	2	13
Total	24	4	28



The causes of fracture shaft femur in children in our study were 15 cases (53.6%) due to fall from height; 8 cases (28.6 %) for road traffic accidents and lastly 5 cases (17.9%) for other causes like direct trauma or assault. As shown in table (2).

Table (2) Causes of femoral shaft fractures

Causes	No.	%
Road traffic accident	8	28.6%
Fall from height	15	53.6%
Others	5	17.9%
Total	28	100%

The types of fracture shaft femur in children in our study were 13 cases (46.4%) with spiral fracture, 11 cases (39.3%) with oblique fracture and 4 cases (14.3%) with transverse fracture. As shown in table (3) and figure (6).

Table (3) Types of fracture shaft femur in children.

Types of fracture	No. of patients	Percentage
Spiral	13	46.4%
Oblique	11	39.3%
Transverse	4	14.3%

The sites of fracture shaft femur in children, according to which third of the femur is affected were 17 cases (60.7%) for the middle third, 7 cases (25%) for the proximal third and 4 cases (14.3%) for the distal third.

Table (5) Sites of fracture shaft femur in children.

Sites of fracture	No. Of patients	Percentage
Proximal third	7	25%
Middle third	17	60.7%
Distal third	4	14.3%

The different types of specicfic treatment and the number of the patients for each type included in our study shows that in early spica we treated by this method 18 patients (64.3%) of our sample, and 10 patients (35.7%) of our cases were treated with spica after skin traction.

Table (6) Methods of treatment of fracture shaft femur in children.

Type of treatment	**No. of cases**	**Percentage**
Early spica	18	64.3%
Delayed spica	10	35.7%

Hospitalization time:

In early spica the hospitalization ranged from 2-5 days; while in delayed spica, the hospitalization time ranged from 16-23 days.

Complications

Initial observation of complications in our patients immediately after removal of the spica were as follow;

In patients treated with early spica were 3 cases (16.5%) had side way angulation, 1 case (5.5%) had shortening, while for anterior angulation one case (5.5%) was recorded.

In patients treated with delayed spica following skin traction complicated by anterior angulation were 1 case (10%) and side way angulation were 2 cases (20%) while no case of shortening reported.

The patients considered here to have a shortening or angulation are only those having a deformity of more than accepted limits (20mm shortening, 15 degrees side way angulation and 20 degrees for anterior angulation).

Table (7) Initial observation of complications.

Complications	Early spica	Percentage	Delayed spica	Percentage
Anterior angulation	1	5.5%	1	10%
Side way angulation	3	16.5%	2	20%
Shortening	1	5.5%	0	0%
Total	5	27.5%	3	30%

P. value = 0.0417

In comparison of complications to both site and type of femoral shaft fracture; for the fracture site we found that anterior angulation totally recorded with middle third fracture, while side way angulation distributed as 3 cases (60%) with middle third fracture, one case (20%) with upper third fracture and one case (20%) with lower third fracture and shortening we have one case (100%) recorded with middle third fracture.

Table (8) complications in relation to the fracture site

	Upper 1/3		Middle1/3		Lower1/3	
Anterior angulation	0	0%	2	100%	0	0%
Side way angulation	1	20%	3	60%	1	20%
shortening	0	0%	1	100%	0	0%

P. value = 0.088

While for the fracture type were the anterior angulation was strictly associated with oblique fracture where as side way angulation distributed as 3 cases (60%) with spiral fracture and 2 cases (40%) with oblique fracture and finally shortening we have 1case (100%) follow also oblique fracture.

Table (9) complications in relation to the fracture type

	Oblique #		Spiral #		Transverse #	
Anterior angulation	2	100%	0	0%	0	0%
Side way angulation	2	40%	3	60%	0	0%
Shortening	1	100%	0	0%	0	0%

P. value = 0.0671

Skin complications after cast application in group 1 occurred in one case (bedsores on the iliac crest and great trochanter), but it required no modification of the therapeutic strategy and resolved rapidly after local treatment.

After four months of follow up for all of our patients, most of the initially observed complications were corrected to the accepted limits. The shortening which reported initially overcome by overgrowth and only 0.8cm length discrepancy was there. For both anterior and side way angulation, they were within the accepted limits. All these patients had a good status of walking and good range of movement in knee and hip joints. In our study there was no case of delayed or non union, no case of abnormal rotation but few degrees of knee stiffness was found in 12 cases subsided with daily physiotherapy after 2 weeks.

Figure (8): X-ray of patients treated by A. Early spica cast. B. Delayed spica cast.

Discussion

Various treatments method exists for management of pediatric femoral shaft fracture. The options include external fixation [34], compression plate, flexible intramedullary nail and spica cast application placed both in early and delayed fashion.

Despite recent concept about malunion, limb length discrepancy and significant skin complications which might occurs with the use of spica still this method is considered by many authors as a treatment of choice for young age groups in addition the complications like pin tract infection, wound dehiscence and scar formation and the need for second surgery to removed hard ware are avoided.

The policy of admitting all children to hospital for reduction of the fracture under general anesthesia and to allows a short period of observation for other injuries and provides time for the parents to be instructed about the care of their child in a spica. The duration of admission for uncomplicated cases is only one to two days [20].

We compared our results to that of the original study which was done by Thomas d'Ollonne and Amandine Rubio in Nice university-France and published on line on 2009 which involved 35 children with closed femoral shaft fracture treated by immediate and delayed spica cast and they follow them for ten years.

Our study revealed that boys 24(85.7%) were affected more than girls 4(14.3%) and the left side cases (53.5%) comes nearly similar to that of right side (46.5%).These results nearly similar to that of Thomas d'Ollonne and Amandine Rubio in which the male: female ratio is (7.8:2.2).

The mean age that recorded in our thesis was (4.34) years for early spica and (5.95) years for delayed spica .This is different from the mean age that appears with Thomas d'Ollonne et al. study in which the mean was (2.4) years for early spica and (3.2) years for delayed one, because the age range of our study was 2-8 years while that of Thomas was 2-6 years.

The causes of femoral shaft fracture in our paper shows that fall from height is the major causative factor recording 53.6% followed by road traffic accident 28.6% and this is a little bit different from Thomas d'Ollonne et al. results which suggest that falls is the first cause followed by falls from height then pedestrian-motor vehicle accidents.

The middle third of the femoral shaft was the most common site of fracture (60.7%) followed by upper third (25%) and lastly the lower third(14.3%) while in the comparative study of Thomas d'Ollonne et al. the cases with middle third fracture were 27 case out of 35 case (77.14%). This is due to distribution of the forces that cause the fractures are maximally applied at middle third.

Our study shows that spiral fracture was the common type of the femoral shaft fracture (46.4%) where as oblique fracture record a nearby result of about (39.3%) ;while that of Thomas d'Ollonne considered the transverse fracture to be the second type after the spiral one. We believed that the cause of this result was due to the indirect forces (twisting force) that were applied to the femur e.g. fall from height which result in spiral type of fracture.

Skin traction and cast application are major factors for pain control. However, patients treated with traction needed more painkillers and anti-inflammatory drugs treatment.

General anaesthesia contributes to successful reduction as it allows relaxation of muscle spasms and complete pain relief [21].We used anaesthesia for all patients treated by early reduction and spica application while we performed delay spica only under conscious sedation without the need for general anaesthesia. Cassinelli [23] used immediate hip spica casting in the emergency room for femoral fracture in children younger than 6 years, under conscious sedation, if there were no associated factors requiring admission (child abuse, polytrauma).

The plaster application technique is fundamental, as it is necessary to obtain and maintain the bone reduction and prevent complications. Whatever the location of the fracture, we always made the same hip spica cast, with a 10-30 degree hip flexion, 10-20 degree hip abduction, and 15-30 degree knee flexion and plantigrad ankle flexion while according to Illgen and Rogers [23], a knee flexion in the spica cast less than 30 degree could increase the risk for secondary displacement. The 2-weeks period following the fracture seems to be a critical period for greater risk of loss of reduction [24] and therefore requires a close follow-up. Maintenance of a post reduction varus less than 5 degree, a valgus less than 10 degree and a flexion angulation less than 10 degree is recommended to maintain fracture reduction [23].

Our results allow the definition of criteria for acceptable positions of the fracture during various stages of treatment. At all ages, and at all stages of treatment, anterior angulations of less than 20 degrees and angulations of valgus less than 15 degrees are acceptable. Angulations in excess of these amounts or in the opposite directions should be corrected by wedging the spica. Correct rotation is achieved by placing the foot in a slightly out-turned position, with an additional 10 degrees lateral rotation for proximal fractures. Acceptable shortening is related both to the age of the child and the stage of treatment. At the one week review and at the time of fracture union the maximum allowable shortening was about 20mm at all ages. Greater overlap might have been corrected spontaneously, but would hardly be acceptable to the parents at the time of spica removal [25].

In this paper we cannot follow the patients for a long period to calculate the overgrowth phenomena that occur after pediatric femoral shaft fractures because this may need more than three years of follow up as Thomas d'Ollonne did in his study. Truesdell [26] in 1921 described that, the fracture healing process

stimulates bone growth in femoral shaft fractures in children. For Shapiro [12], the overgrowth is independent of age and fracture level. Considering the initial shortening during the immediate reduction would prevent this overgrowth. Berne and Filipe [27] estimated that a shortening between 5 and 15 mm at the bone union prevents this phenomenon. In our study, the mean shortening was within these limits. If the initial reduction was not satisfactory, the cast was redone or a gypsotomy was carried out in order to obtain these criteria of good reduction. At late review, leg-length discrepancy was uncommon and insignificant; the rarity of leg-length discrepancy at late review supports previous reports that growth stimulation is directly proportional to the amount of shortening [28] .Many authors have demonstrated that overgrowth occurs during the first 2 years following the trauma [12, 20] and is maximal between 3 and 7 years [29]. Others authors have shown a linear relationship between initial shortening and overgrowth [30, 26].

Regarding the total percent of complications, our results showed that early spica application had a rate of (27.5%) which is less than that of delayed spica (30%).The side way angulation was more than other types of complications in both treatments modalities; for early spica 3 children (16.5%) and in delay spica 2 cases were recorded account for (20%) followed by anterior angulation (5.5%) for early spica and (10%) with delayed one and lastly we have only one case of shortening (5.5%) occurred with early application of spica . Also in our series we noted that the middle third fracture and the oblique one carries the highest rate of complications. These results were little different from Thomas d'Ollonne study which is had been postulated that anterior angulations comes first with (18.3%) for early spica and (16.7%) with delayed spica while middle third fractures come with higher rate of complications than others. The skin complication was insignificant occurred only in one case with early spica application and subsided with local treatment only.

Our protocol for the early spica treatment of femoral fractures has substantially reduced the cost of treatment and has freed beds for use by other children. It is also in accordance with the general trend towards shorter hospital admissions for children [20].

It is important to ensure that the parents understand the natural history of recovery. They are often disturbed by the radiographic appearance of a transverse fracture with bayonet apposition and by obvious clinical shortening when the spica is removed. It is necessary to explain that the children are usually stiff and uncomfortable when the spica is removed and will not use the leg for several days, and that even when they start to stand and walk they will have a severe limp due to weakness and shortening. They should be informed that the child's gait will improve over a few months and the leg-length discrepancy will correct over a few years [31].

Conclusion

1. Fracture shaft femur in children treated by early spica cast or skin traction followed by spica cast proved to obtain good results in spite of the presence of some degrees of shortening or angulation, which prove to be limited at the end of follow up.
2. Early spica had the superiority over delayed spica cast, in less hospitalization time, thus the parents and the patients will be more compliant.
3. Decreasing hospitalization time will allow more free beds for other patients.
4. Patients treated with delayed spica casting will have less complication regarding shortening but more percentage with angulations.
5. Patients care is easier to the family in early spica.
6. The cost effect is much lower in treating the patients with early spica cast for the family and the hospital since delayed spica needs 5-7 times more than hospitalization time needed for early spica.

Recommendations

We recommend that:

1. Early spica casting as a treatment of choice for closed fracture shaft femur in children between 2- 8 years.
2. A long period of follow up for all patients treated with spica cast whether early or delayed in order to overcome complications.
3. The parents should be informed that the radiographic picture is deceiving and the end result is expected to be better than operative treatment.
4. For the future studies along period of follow up more than three years for a larger sample of patients in order to calculate the overgrowth phenomenon which is happen after pediatric femoral shaft fracture.

References

1. **American Academy of Orthopedic Surgeons**. Orthopedic knowledge updates 9, p.709-712, 2008.
2. **A. Graham Apley**. Apley's system of orthopedic and fractures. 9th edition p.859-870, 2010, 8th edition p.695-701. 2001.
3. **Thomas d'Ollonne .Amandine Rubio. Julien Leroux .Simon Lusakisimo .Toni Hayek .Jacques Griffet** .Early reduction versus skin traction in the orthopaedic treatment of femoral shaft fractures in children under 6 years old. J child Orthop (2009) 3:209-215 DOI 10.1007/s11832-009-0174-9
4. **Williams and Warwick** . Grey's anatomy. 36th edition, p.1221-1229, 1983.
5. **Greene – WB**. Displaced fractures of femoral shaft in children. Clinical orthopedic p. 86-96, 1998.
6. **Richard S.Snell**. Clinical anatomy for medical student, 2nd edition, p.493-511, 1981.
7. **James H. Peaty**: Femoral shaft fractures in children. vol. 3, no.4. Journal of American academy; 1995.
8. **McRae practical fracture management**, p.247, edition19.
9. **Clinkscales-CM, Peterson-HA**.: Isolated closed diaphyseal fractures of femur in children. Orthopedic vol.20, p.1131-1136, 1997.
10. **Wessel L**: Leg length inequality after childhood femoral fractures. Unfallchirurg; April (99): 275-282 ; 1996.
11. **Corry I.S., Nicole R. O.**: Limb length after fracture shaft femur in children. J. Pediatric Orthop. March / April: 217-229; 1995.
12. **Shapiro F**.: fracture of femoral shaft in children, overgrowth phenomenon. Acta Orthop. Scand. 52: 649 – 655; 1981.
13. **Griffin P, Anderson M, and Green**: fracture shaft femur in children treatment result. Orthop. Clin. North Am. 3213 – 229 .1972.
14. **Truescfell E.D.**: Inequality of lower extremity following fracture shaft femur. Children Ann. Surgery 74: 498-500; 1981.
15. **Atkin A.P., Blokelly C. W. and Cinco Hib**: Overgrowth of fracture shaft femur in children. J. B. J. Surg. 21: 343-338, 1993.
16. **Wallace M. E., Hoffman E.B.**: Remodelling of angular deformity after fracture shaft femur in children. J. B & J. surgery. September 74 (5): 765-769; 1992.
17. **Brower JC**. Rotational deformity after femoral shaft fracture in children. Acta Orthopedica Scand. 52: 81-89; 1981.
18. **Ikpome J. O**.: Quadricepsplasty following fracture shaft femur in children. Injury 24: 104-108; 1993.
19. **Mototugu Sugi and William G. Colli**: Early plaster treatment of femoral shaft fractures in children. Journal of B&J vol.69, no.5 Nov.1987.
20. **Reynolds DA (1981) Growth changes in fractured long-bones**: astudy of 126 children. J Bone Joint Surg Br 63:83–88
21. **Routt MLC (1994) Fractures of the femoral shaft. In**: Green NE, Swionkowski MF (eds) Skeletal trauma in children. WB Saunders,Philadelphia, pp 345–368
22. **Cassinelli EH, Young B** (2005) Spica cast application in the Emergency Room for Select Pediatric Femur Fractures. J Orthop Trauma 19:709–716.
23. **Illgen R, Rodgers WB (1998) Femur fractures in children**: treatment with early sitting spica casting. J Pediatr Orthop 18:481–487.
24. **Martinez AG, Carroll NC, Sarwark JF, Dias LS, Kelikian AS,Sisson GA Jr** (1991) Femoral shaft fractures in children treated with early spica cast. J Pediatr Orthop 11:712–716
25. **Rab GT (1992) Femur fractures in children. In**: Hensinger RN(ed) Operative management of lower extremity fractures in children. American Academy of Orthopaedic Surgeons, Monogaph Series, Park Ridge, IL, pp 25–31
26. **Truesdell ED (1921)** Inequality of lower extremities following fracture of the shaft of the femur in children. Ann Surg 74:498–500.
27. **Berne D, Mary P, Dasmin JP, Filipe G (2003)** Fracture de la diaphyse fe´morale de l'enfant: traitement par plaˆtre pelvi-pe´dieux d'emble´e. Rev Chir Orthop Repar Appar Mot 89:599–604
28. **Routt MLC (1994) Fractures of the femoral shaft. In**: Green NE, Swionkowski MF (eds) Skeletal trauma in children. WB Saunders,Philadelphia, pp 345–368
29. **Corry I.S., Nicole R. O.**: Limb length after fracture shaft femur in children. J. Pediatric Orthop. March / April: 217-229; 1995.
30. **Jawish R, Kahwaji A, Dagher G (2003)** L'exce's de croissance dans les fractures du fe´mur chez l'enfant. Rev Chir Orthop Repar Appar Mot 89:404–406

31. **Coyte PC, Bronskill SE, Hirji ZZ, Daigle-Takacs G, Trerise SB, Wright JG** (1997) Economic evaluation of 2 treatments for pediatric femoral shaft fractures. Clin Orthop Relat Res 336:205–215.
32. **Beaty, James H.; Kasser, James R.** Rockwood & Wilkins' Fractures in Children, 6th Edition. 2006.
33. **Nordin S, Ros MD, Faisham WI.** Clinical measurement of longitudinal femoral overgrowth following fracture in children. Singapore Med J.2001 Des; 42(12):563-5.
34. **Omer A. Rafiq Barawi ,Saman H. Khursheed** .Treatment of femoral shaft fracture in children by close reduction and external fixation.

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