

Study of Ender's Nailing in Shaft Femur Fractures of Older Children

Author: Dr.Himanshu G. Ladani*

Introduction:

Fractures in shaft femur in children are relatively common. Various methods of treating these #s starting from non-operative to methods like closed intramedullary nailing are at our disposal. Traditionally non-operative methods are acceptable and find wide acceptance even today in very young children. Satisfactory results have been reported with cast bracing, immediate spica cast application, longitudinal skin traction, ordinary Russel traction, split Russel traction and 90-90 skeletal traction.^{1,2}

In children younger than 2 yrs. Skeletal or skin traction is satisfactory. Immediate spica cast is recommended by several authors including Clement and Cotton,³ Griffin, Anderson and Green,⁴ Irani, Nicholsan and Chung,⁵ Neer and Cadman,⁶ and Staheli⁷ and Shridan. In young children also these methods give good results. However, in older children certain problems are encountered. They are :- (1) Failure to control angulation and shortening (2) prolonged immobilization is necessary. In a study by Arenson, Singer and Higgin patients on an average spent 24 days in traction and wore hip spica cast for an average of 58 days. (3) Humberger and Eyring⁸ reported a higher incidence of knee pain, angulations at fracture site and difficulty in maintaining length where 90-90 traction was used in children older than 10 yrs. (4) The overgrowth phenomenon – In 1921 Truesdall reported overgrowth of extremity and later Bisgard showed that this is due to acceleration of growth at the epiphysis of fractured femur. Later on several studies confirmed this phenomenon.^{9,10}

In view of above difficulties, closed intramedullary nailing was attempted in older children and in adolescents. Reports indicate that medullary fixation of femoral shaft fractures in adolescents result in high rates of union with short hospital stay and brief period of immobilization. Various intramedullary devices used for these purpose are Kuntscher nail, Rush nail and Elastic stable intramedullary nails (ESIN) like Ender's nail. I have tried to study 23 cases of shaft femur fractures in older children treated by Ender's nails.^{11,12}

Materials and methods:

22 pts. ranging from 7 to 16 yrs. of age operated with Ender's nailing were included in this study. Selection criteria for upper age limit was presence of growth plate in pre-ope. radiograph. For lower age limit there was no strict criteria. It was 7 to 8 yrs. depending on the factors like skeletal maturity, stature of the child, fracture displacement & comminution, pre-existing conditions, other injuries and socio-economic conditions. One pt. in this study had bilateral shaft femur #, he was studied as two separate cases, thus the study was of 23 fractures. The words 'patients', 'cases' and 'fractures' are interchangeably used at appropriate

places. 3 pts. had polio limbs, they were studied separately regarding their clinical and radiological assessment.

Age ranges- between 7-9 yrs 3 pts., 10-12 yrs. 8 pts. and 13-16 yrs. 11 pts. were there. Average age was 12.5 yrs. 19 were males and 3 were females. 12 were left sided & 11 were right sided #s. Mode of injury in 17 pts. was road traffic accident and in 5 pts. was fall from height. Out of 22, 3 pts. were having polio, 1 pt. was having epilepsy and 1 pt. was having anaemia as pre-existing condition. One pt. was having associated urogenital injury, one was head injury and 3 pts. were having shock. One pt. was having same side associated wrist # and 3 pts. were having soft tissue injury at other places.

Fractures were classified in all aspects: exact site in the femur, type of fracture- whether transverse, oblique, spiral or with comminution, and whether fractures were open, close or with deep abrasion at # site. Site of fractures: upper third – 5, middle third- 13, lower third- 3 and involving more than one region- 2. Type of fractures: transverse- 6, spiral- 3, oblique- 12 and comminuted- 2. 18 were closed #, two were open grade II, two were open grade III and one was having deep abrasion at fracture site.

Skin traction was given in all pts. at the time of admission to keep limb in as much reducible position as possible and also to decrease pain at # site. It was left in situ if an early surgery was anticipated, but was respectively changed to skeletal traction (2 pts.) or external fixator (2 pts.) or hip spica (2 pts.) within few hours if surgery was likely to be delayed, fracture were open or conservative management was initially planned. Operation of Ender's nailing was done on first day in 5 pts., between 2-3 days in 11 pts., between 4-7 days in 2 pts., between 8-15 days in 3 pts. and more than 16 days in 2 pts. In two pts. of open #s external fixator was done initially and Ender's nailing was performed as the open wounds healed.

The child was positioned on the orthopaedic # table in supine position under general anaesthesia. The proximal & distal growth plate were inspected with IITV. The number & size of nails used depends upon the diameter of femoral canal at isthmus, type of fracture and length of bone. Generally one or two (or rarely three) 3.5 or 4.5 Ender's nails were required in children. The length of the nails was measured by placing the nails over the drapes and seeing their position in IITV. Distally they should be proximal to growth plate by about 1.5 cm. and proximally they should fall short of proximal epiphysis by about 1 to 1.5 cm. A C – shaped curved is given and the tip is bent slightly more than the curve.

We preferred entry of the nail from medial and distal end of the femur, not violating the epiphysis. About 7 cm. incision is marked on adductor tubercle. Skin, subcutaneous tissue was incised in the line of incision. Vastus medialis was identified, overlying fascia was cut and the muscle was retracted anteriorly. Medial genicular vessels were cauterized. Small hole was drilled in the bone sufficient for the entry of one or two Ender's nails. Proper sized nail was

pushed through the hole and hammered upto the fracture site. Reduction was achieved and nail was driven further under IITV guidance to reach 1.5 cm. short of proximal epiphysis of femur. Manipulation with the nail with help of introducer may aid the reduction. Depending upon bone size and diameter at isthmus and type of fracture, second nail was inserted in some cases for achieving and maintaining better reduction at fracture site. In 4 cases a separate entry site was chosen at lateral side just opposite to medial entry point. This also helped to achieve and maintain reduction in a better way. A third entry point was taken in one case below the greater trochanter (not violating the apophysis). The fracture in that case was distal third and one entry point from medial side was already made. Layer wise suturing done.

In most of the cases that were operated early, reduction was possible without opening the fracture site. In 3 pts. which were operated late, open reduction was needed. And in one case reduction could not be achieved under IITV, fracture site had to be opened for reduction. Average time of surgery was 45 minutes and the blood loss was about 40 cc where closed reduction was achieved. Blood loss was about 100 cc where open reduction was done. Post operatively none of the pts. were given traction, hip spica or cast post-operatively. Knee bending and quadriceps exercises were started from the next day of surgery. All the pts. were kept non wt. bearing for one and half month followed by partial weight bearing for further 3-4 weeks. Patients were called at the interval of one, two, three and five months. They were clinically and radiologically assessed for union, mobility and complications. Removal of implant is mandatory in growing children in view of growing bones. Nails were removed as soon as clinical and radiological evidence of solid union was present, usually 5-6 months after surgery.

Results:

The results of these study were calculated from 20 pts. 3 pts. with polio limbs were studied separately. Full weight bearing was possible in all the pts. at final follow up. No pain and /or swelling was noted at fracture site in any of the pts. In 19 pts., there was no muscle wasting. It was noted only in 1 pt. Hip and knee movements are studied by the range of movement, sitting cross legged, squatting and cycling, which give a good idea about the mobility of these joints. Function of hip and knee was assessed by criteria that depends upon the degree of restriction from the standard range of movements of these joints.

Degree of restriction	Functional assessment
0 – 10	Excellent
11 – 20	Good
21 – 35	Fair
More than 35	Poor

According to above criteria in all the cases excellent range of motion of hip joint could be achieved. And in 19 cases excellent knee movements were achieved, only in one pt. knee

movement was fair. Sitting cross legged, squatting and cycling was possible in all but one pt. without difficulty. Limb length was equal in 17 pts., shortening in 2 pts. (1cm. and 2cm.) and lengthening in one pt. (1 cm).

In pts. with polio limbs, range of movements of both hip and knee were equal to pre-injury level in all the pts. There is delayed union in all the cases. Rehabilitation was good, with all the 3 pts. returning to their work / school.

There were no infections in any cases. In one pt. broken nail was seen in follow up x-rays. Average union time was 10 weeks and no nonunion seen. Well formed callus was seen in x-rays of all the pts.

Discussion:

Though, in general this treatment gives favorable results in older children, there are certain factors that should be considered. They are fracture type, pre-existing condition, age of the child, associated injuries and socio-economic condition of the patients. Keeping in mind these factors each patient should be individually considered while deciding for surgery. In older children and adolescents where joint stiffness is more common after conservative treatment, and where reduction is not possible to maintain, this method of Ender's nailing is definitely better.

In poliomyelitic pts. it was decided to operate so as to start early mobilization that would not have been possible with conservative methods as the union is usually delayed. Partial weight bearing can be started after 1 & ½ months, and though, clinical and radiological union is delayed, morbidity by keeping the limb in spica cast or in traction for more than usual period can be avoided. In one pt. with epilepsy, it was decided to operate so as to facilitate medical management of the patient. Thus, some medical problems can be tackled in a better way after operating with Ender's nailing. Operation should be performed as early as possible in all the cases, as union is rapid in children and if reduction is not maintained, soft tissue contracture can make reduction difficult.

We are not giving hip spica after operation as advocated by some authors. Antibiotics are usually used prophylactically. In all the patients except one, mobility of hip and knee joint was good to excellent by three months. One pt. had restricted movements at knee, he was not following the advise of physiotherapy properly. Patients were advised for removal of the implant after clinical and radiological evidence of union was there. It is mandatory in view of growing bones of the children. Most of pts. except 3 pts. came for implant removal. The 3 pts. who did not came for implant removal, were from low socio-economic class and illetterate and second surgery was not acceptable to patients and their family.

In 85 % of the patients, there was no limb length discrepancy. This is an advantage over conservatively treated patients, where overgrowth occurs in majority of the patients.^{9,10} Two patients with shortening had comminuted fractures, and was operated late by 8 days and reduction was not very good. One patient started walking within 3 weeks of surgery, finally resulting in implant breakage. Clinically that patient had excellent range of motion of hip & knee and radiologically a well formed callus was seen. If surgery is properly performed taking care of epiphyseal growth plate, bone growth is not disturbed. Complications of spica cast like compartment syndrome and superior mesenteric artery syndrome can be avoided by surgical treatment. In closed method infection rate is very low. This is a better method than skeletal traction, where pin tract infection rate is high and this may even lead to chronic osteomyelitis. Over all morbidity of the patients decreases considerably with treatment of Ender's nailing.

Conclusion:

The results of this study in general, strongly favor the use of Ender's nailing in shaft femur # in older children. However, it is again stressed that each patients should be individually considered while the decision is being taken for surgery considering the factors like age, pre-existing conditions, fracture type & comminution and stature of the child. In India two other factors- level of education of the patient & his parents and the socio-economic conditions should also be considered. Second surgery of implant removal is mandatory and patient/relative has to be explained thoroughly. This method of treatment is especially recommended for polio patients, where inspite of delayed union mobilization can be started much earlier. Surgery of Ender's nailing should be performed as early as possible after injury in all cases. There is no problem of joint stiffness as the mobilization is started earlier. This method facilitates management of pre-existing medical conditions.¹³ Closed reduction can usually be achieved if surgery is done earlier. Infection rate was nil. Average union time was 10 weeks (except polio pts.). No non-union were there. No major limb length discrepancy was observed.

References:

1. Charney, Closed Treatment of Common Fractures, 3rd edition, 1970.
2. James R. Ryan – 90-90 Skeletal Femoral Traction for Femoral Shaft Fractures in Children; Journal of Trauma; Vol. 21, No. 18, page. 46-48, 1981.
3. Clement D.A., Cotton C. L., -Overgrowth of Femur after Femoral Fractures in Childhood ; Journal of Bone and Joint Surgery ; 68 – B ; 534, 1986.
4. March, Paul P. Griffin, Margaret Anderson and Green – Fractures of Shaft of Femur in Children – Orthopaedic Clinics of North America pg. 213 - 223, 1972.
5. Irani R. , Nicholson J, & Chung S. Long Term Results in Treatment of Femoral Shaft Fractures in Young Children by immediate Spica Immobilization. Journal of Bone and Joint Surgery 58 – A, 945, 1976.

6. Neer C. and Cadman E – Treatment of Fractures of Femoral Shaft , JAMA 163 ; 634 , 1957.
7. Staheli L. – Femoral & Tibial Growth Following Femoral Shaft Fractures in Children. Clin. Orthop. 55: 159 , 1967.
8. Humberger FW & Eyring EJ – Proximal Tibial 90-90 Traction in Treatment of Children with Femoral Shaft Fractures, Journal of Bone & Joint Surgery; 51 A , 499 , 1969.
9. August , P Evardson, S. M. Syverson – Overgrowth of Femur after Fractures of the Shaft in Childhood, Journal of Bone and Joint Surgery , 58 – B, No. 3, pg. 339 – 342 , 1976.
10. May, Bathfield, Versield – Overgrowth after Femoral Fracture in Children ; Journal of Bone and Joint Surgery, 256 -257 ,1979.
11. David C. mann, Davenport et. al. – Closed Ender Nailing of Femur Fracture in Adolescents ; Journal of Paediatric Orthopaedics pg. 651 -655 , 1986.
12. Kissel , Miller et. al. – Closed Ender Nailing of Femur Fracture in Older Children ; Journal of Trauma vol. 29, No. 11, pg. 1585 -1588 ,1989.
13. Kirk , Fry, Hoffer, Brink- Femoral Shaft Fractures in Brain – Injured Children ; Journal of Trauma pg. 371 -373 ,1976.