Journal Of
Maharashtra Orthopaedic Association
September - 2005

Management of Femoral Shaft fractures in Children

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Fractures of shaft of femur are one of the common injuries sustained in children. It can occur singly or as a part of multiple injuries. Management of these fractures have been usually conservative in our country first because some amount of malunion or shortening is usually compensated by growth and secondly because of the objection to any surgery if it can be treated non-operatively. This is acceptable in children below 4 years, where the fracture heals in a very short time and the management of these children is not problematic at home to the parents

Regarding the children above 12 years, since any amount of shortening will not be acceptable, and the period needed for the conservative treatment will be really too long, operative treatment is accepted. This could be in the form of plating or even interlocked intramedullary nailing.

Regarding the children between the ages of 4 to 12 years, the problem is slightly different. The conservative treatment entails the first period of traction in the hospital for a two to four weeks (depending on the age) followed by application of spica cast. This means an absence from school for about 8 weeks or more. Besides, the constant attention by one of the parent, who may be working has to be taken into account. This can be shortened if the fixed operatively in such a way that the child can be mobilized immediately. Plate fixation involves extensive dissection of soft tissues, gives rise to a scar, which can turn into a keloid and a second major procedure (with post operative protection) for the removal of the plate.

Fixation of the fractures in children by elastic intramedullary nails have been described from 1989 and has been carried out extensively in Europe. Enders nailing in adult femoral fractures have been extensive published and is being carried out routinely by some surgeons in our country. Similar procedure in children is still not common.

We are describing below our experience in managing the fractures of femur in children aged between 4 and 12

Materials and methods

From Jan 2000 to Dec 2001, thirty-two patients between the ages of 4 and 12 have opted for and have been operated by this method. Besides another 20 cases treated elsewhere form the study undertaken.

40 were males and 12 females. The mean age was 6.2 years. The fracture was transverse in 37 cases and the remaining, oblique, spiral or comminuted. All were closed injuries. There was abrasion at the fracture site in 3 cases. Associated injuries in the form of forearm fractures were in 10 cases. There was no major associated injury. None of them were due to high velocity trauma. There was one case of a fracture in the subtrochanteric region where a plate, which had been fixed for a varus osteotomy, had been removed

Most of the cases reported within 5 days after the injury. There was one case where the patient who had treated conservatively sustained a re-fracture at

the fracture site at 2 months. 8 cases reported after the initial conservative treatment for 2 weeks with mal-alignment. All were operated within 24 hours after presentation. All were discharged by the 5th day after the surgery.

Two nails were used in all cases. 3 mm nails were used in 3 cases who were 4 years of age. 4 mm nails were used in 5 cases who were between 10 and 11 years of age. In 44 cases 3.5 mm nails were used. The length of the nails was shorter than ideal in 11 cases.

In 5 cases closed negotiation was difficult because the fracture was more than 3 days old. This included the 2 months old case mentioned above.

Operative technique

The patient is positioned on a fracture table with adequate traction to the affected leg. Draping is done in such a way that the C arm can move all around freely to visualize the hip, knee and the whole shaft in both views.

- Under C arm control a 3 mm K wire is drilled into the lateral cortex of the femur about cm proximal to the epiphyseal plate.

- An incision 2 cm long is made at the site of K wire entry

- A bone awl is introduced and the entry hole made wider. At the same time a slope is also given to facilitate the easy nail entry.

- The proper size Enders nail is selected. The thickness used depends on the size of the medullary cavity. Two nails should not get jammed but should fit snugly into the medullary cavity. For example, for a medullary cavity with isthmus of 7 mm diameter two 3 mm nails should be used. The length is estimated by keeping a nail on the thigh and visualizing on the C arm. The medial entry nail can be a cm longer because it goes into the neck.

- The nail is pre-bent to a gentle C shape. It is then inserted into the medullary cavity through the entry hole made by the awl. It is inserted in such a way that the bevel of the nail slips along the opposite cortex.

- The nail is then gently hammered in by tapping on the introducer. The introducer prevents the nail from rotating and also helps to rotate the tip of the nail, if necessary, during negotiation of the fracture site

- On reaching the fracture site it is negotiated into the proximal fragment under C arm control. Unless the fracture is a few days old and callus has formed, this step is not difficult. Once the fracture site has been negotiated, it is pushed in so that the tip lies just short of the trochanter and the proximal end is well outside the bone but under the skin.

- The same procedure is carried out on the medial site with the tip of the nail into the neck, just short of the capital epiphysis and the proximal end, under the skin. Because of the first nail in position, the introduction of this nail is comparatively easy

- After checking the final seating of the nails under the C arm, the skin wounds are closed.

The nails will be found criss crossing each other either at the fracture site or somewhere in the medullary canal. This fixation by six points (3 of each nail) stabilizes the fracture well enough to mobilize immediately.

Postoperative management

No external immobilization is necessary. The child is made to mobilize the knee at the earliest, as the pain will allow. Within 2 or three days, weight bearing is permitted initially with a walker and later as the patient wishes. The patient is discharged from the hospital by the 5th or 6th day and asked to come on an out patient basis to remove the sutures. They are called weekly for follow up till 8 weeks. X rays

are taken at the end of 4 and 8 weeks. They are able to attend the school usually at 4 weeks. Clinical examination at the end of 8 weeks showed full painless movements at the hip and knee. There is usually a slight irritation at the proximal end of the nail, which is subcutaneous. Radiologically too, at 8 weeks, the fracture shows union with enough external callus.

Implant removal

Removal of the nails is advised at the end of 6 months. This was done as an office procedure under a short general anaesthesia. The patients could continue unprotected weight bearing and did not lose any school days. Leaving the proximal end slightly more than usual prompted them to come for removal.

Results

Full recovery was seen at 4 weeks in 40 cases and ad at 6 weeks in 12 cases. That is the patient was able to squat and sit cross-legged. He was able to walk independently and able to dress himself. Adequate callus was seen on the radiographs.

Complications

There were no infections, superficial or deep.

In 2 cases, during surgery, on attempting to remove the nail for exchange with a longer nail, the eye of the implant broke and the extraction had to be done with a vice

In 8 cases closed reduction was difficult, due to delay of more than three days between injury and surgery. There was maximum difficulty in the 2 months old case, but it was finally done closed.

In 5 cases the proximal tip of the nail had remained very subcutaneous and due to its irritation the regaining of knee flexion was delayed.

Keloid formation of the skin incision was seen in 3 cases.

There has been no breakage of implant till today. (Not reported)

Discussion

Fracture femur in children can occur singly or along with other injuries in a poly-trauma. When there are multiple injuries, early internal fixation is the rule, to ensure early stabilization of the patient and good nursing care. In case of open fractures, the fracture is stabilized by external fixators, which may be continued till bony union. In children of ages 13 and above interlocking intramedullary nailing can be done with early mobilization.

When there is an isolated fracture femur in children between the ages 4 and 12, the question arises whether it is really necessary to internally fix these fractures, because non-operative treatment can lead to an excellent end result. Conservative treatment consists of, a couple or more weeks of traction- properly monitored- and a further few weeks of hip spica, followed by at least a couple of weeks of rehabilitation. This non-operative treatment at the most favorable estimate, will entail a period of 8 to 10 weeks of confinement to bed (about 3 to 4 weeks in the hospital and remaining at home depending on the age). About 3 months of absence fro the school is the routine.

With the stable fixation made possible by fixation of two C shaped Enders' nails, the child is not restricted to the bed more than a week. These two nails create a 6-point fixation (Kiely N et al). Vransky has described a similar procedure, but has reported encouraging results only up to a maximum of 5 years of age. Havranek et al have extended the indications of such fixations to other bones like metacarpals, metatarsals and phalanges. Schlickewei et al have described that this (E S I N) is a biological, minimally invasive treatment to achieve a high level of reduction and stabilization in fractures of children. Scmittenbecher has described the different intra operative and postoperative problems.

Lee S S et al, who have done the biomechanical testing have shown that "the length and rotational control of comminuted mid-shaft femur

fracture with two divergent Ender nails may be sufficient for early mobilization". Till who does E S I N also in other bones, has found overall length discrepancy of 4.1mm (+/- 5.2mm). Linhardt has designed paediatric Ender nails that can be interlocked. He had locked only at the site of insertion. We have found that it was not necessary to lock, if the tip of the nail lies outside abutting against the cortex. Heinrich in his experience of 77 cases has reported about 8 degrees of translation or rotary mal-alignment. Bartl V has reported on his experience of ESIN in 21 children with femoral fractures. He has allowed the children to start non-weight bearing immediately but has advocated to start partial weight bearing only from the third week. We have not found the necessity for waiting so long. Hertlein has compared the two different modalities of treatment. 12 children with fracure shaft femur treated conservatively were compared with 12 children treated with Elastic Intramedullary nailing. Comparably good functional results were found in both methods. The mean hospital stay with patients treated conservatively was 36.5 +/- 2.2 days while that of operatively treated patients was 7.0 +/-3.5days

It is worthy to note that this E S I N has been described and published mainly in Europe. Flynn in 2001 has reported on a multi-center study on the early results of use of titanium elastic nails for peadiatric femoral fractures.

Conclusions

Enders nailing as described above is a good method of treating femoral fractures in children between the ages of 4 and 12. The technique is simple and easy to learn. The incisions are small and blood loss is minimal. The epiphyseal plate is spared. No special post-operative immobilization is needed. The patients are spared the punishment of having to be in bed for 8 to 10 weeks. They do not lose more than 2 weeks of school. This Intramedullary Elastic Pinning represents a simple technique which supports or even enhances the natural process of fracture healing of the growing bone. [Reinberg O]

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