DIFFERENT TYPES OF FEMORAL SHAFT FRACTURE; DIFFERENT TYPES OF TREATMENT: THEIR EFFECTS ON POSTOPERATIVE LOWER LIMB DISCREPANCY

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Femoral shaft fracture in child is a disabling injury. Different methods of treatment can be used for femoral shaft fracture and depends on patient condition. The aim of the study was to evaluate lower limb discrepancy following different method of treatment and possible related factors especially type of fractures.

Material and methods. This retrospective cross sectional study was carried out in Imam Khomeini and Razi Hospital from 2003-2007 on children admitted to hospital with femur fracture. All children aged <12 years of age with diagnosis of femoral shaft fracture were included in this study. Different methods of treatment were flexible intramedullary nailing, rigid intramedullary nailing with Steinmann pin and spica casting, spica casting and closed reduction, and ORIF with plate and screw. Distance from hip to knee for each patient was determined in scanograms. Sex, age, side of involvement, type of fracture were recorded for each case. Analysis was done with SPSS ver. 16.0. ANOVAs, Chi-Square, and t-Test were used with CI=95%.

Results. In this study, 253 cases (M=182, F=71) were included. One hundred forty-six (57.7%) cases had right involvement and 107 (42.3%) of cases had left side involvement. From all cases, 135(53.4%) cases had no changes in lower limb length. Eleven (4.3%) cases had lower limb shortening and 107(42.3%) cases had lower limb lengthening. Type A1 and type A2 showed greatest lower limb discrepancy among cases who underwent ORIF with screw & plate fixation, and spica casting with closed reduction respectively (p<0.05).

Conclusions. There is significant difference among surgical and non surgical treatment for LLD. Spica casting and closed reduction has the least changes compared to other methods. Sex, side of involvement, type of fracture, and location had no effect in post operative length changes. Type of fracture, only, has a role in screw and plate fixation group and this is may be due to the differences between A1 and A3 fractures. Most of the changes were seen in the range of 60 through 120 months of age. Most of the changes were in the range +10 to +20 mm.

Key words: femoral shaft fractures, intra-medullary nailing, leg length discrepancy, children, screw and plate

Femoral shaft fractures constitute 1.6% of total bone trauma in children. Femoral fractures in children are a disabling injuries that, together with tibia and forearm fractures, constitute the most common pediatric long bone injuries (1, 2). Male/female ratio was 2.6/1 with 2 peaks, early in childhood and second in the middle of adolescence (3). Different methods of treatment can be used for femoral shaft fractures and depends on patient condition. These methods are spica casting, traction and spica casting, external fixation, pin and plaque, and locked or flexible intramedullary nailing (4, 5). Following treat-
ment, different type of complication may occur as follows: infection, delayed healing, angular deformity, neuromuscular injury imaging, difference in lower limb length. From these complication, lower limb difference is most common complication (2). Overgrowth after femoral fractures were reported previously (6, 7). But in most study, one or two groups of treatment was compared (8, 9). In this study, we compared 4 different methods of treatment.

The aim of this study was to evaluate effect of different methods of treatment and type of fracture on lower leg discrepancy among Iranian children.

MATERIAL AND METHODS

This retrospective cross sectional study was carried out in Imam Khomeini and Razi Hospital from 2003-2007 on children admitted to hospital with femoral shaft fracture. All children aged <12 years of age with diagnosis of femoral shaft fracture were included in this study. Flexible intramedullary nailing(IMN), spica casting and closed reduction, ORIF with screw and plate fixation, and rigid intramedullary nailing with Steinmann pin and spica casting were used in this study.

Rigid IMN with Steinmann pin and spica casting is a method that modified by author (fig. 1). Because flexible IMN is expensive method (600 U$ dollar for nailing), some parents chose less expensive methods. We used Steinmann pin instead flexible IMN and fix (3-20 U$ dollar for pin) with spica to prevent rotation (fig. 1). We curved head of Steinmann pin after insertion. Distance from hip to knee for each patient was determined in scanograms. Sex, age, side of involvement, and type of fracture were recorded for each case. We used Orthopedic Trauma Association Classification for femoral shaft fracture (10). Analysis was done with SPSS ver 16.0. ANOVA, Chi-Square, and independent sample t-Test were used with CI=95% and alpha=0.05.

RESULTS

In this study 253 cases were included. Seventy one (28.1%) cases were female and 182 (71.9%) cases were males. Right side involved in 146 (57.7%) of cases and left side involved in 107 cases (42.3%). In this study, 145 cases underwent surgical treatment and 108 cases underwent non-surgical (spica casting with closed reduction). Surgical treatments are screw and plate fixation, flexible intramedullary nailing, and rigid IMN pin (Steinmann) with spica casting.

Mean±SE of LLD(mm) in non-surgical treatment were 1.93±5.42 and in surgical groups were 6.33±7.13 (p<0.05). In patients underwent ORIF with screw and plate fixation, there is significant differences between type A1 and A3 for LLD (A1=11.10 mm, A3=3.09, p=0.001) (tab. 1).

From 253 cases, 135 cases (53.4%) had no changes in the lower limb length. Increased length was seen in 107 cases (42.3%) and decreased length of lower limb was seen in 11 cases (4.3%).

In this study, 63 cases with type A1 and 45 cases with type A2 of femoral shaft fractures were included. Among cases who underwent spica casting and closed reduction, lower limb discrepancy was significantly greater in type A2 fractures (tab. 2). In patients underwent ORIF with screw and plate fixation, there is significant difference between type A1 and A3 for post operative lower limb discrepancy.
Different types of femoral shaft fracture: treatment and effects on postoperative lower limb discrepancy

Correlation coefficient for age and lower limb length in plate fixation group showed there is inverse relation and shows with age advancement, lower limb lengthening due to surgery will be decreased (p<0.05). There is no correlation between age and length changes in other groups (p>0.05) (tab. 3).

Range of changes in femoral limb length was shown in tab. 4. Most of the cases treated by spica casting and closed reduction has no changes.

**DISCUSSION**

In this study, the aim was to evaluate difference in lower limb in children aged <12 yr with femoral shaft fracture who treated with different methods. Initially 307 patients were selected to include in this study. Fifty-four cases did not agree to participate in our study.
Finally 253 cases were included in this study. In our study, 53.4% of cases had no changes, 42.3% had positive changes, and 4.3% had negative changes following treatment. Most of them was observed following pin and plaque treatment and were in range 10 to 20 mm. Limb shortening was mostly follow casting and spica method and were in 0 to 10 mm. In our study, mean of changes in non surgical method was 1.93 mm and in surgical methods were as the following: Plate fixation 6.6 mm, flexible IMN 3.86, rigid IMN pin and spica 5.08.

Holschneider et al reported non surgical methods had 0.24 cm and surgical methods 1.2 cm had leg length inequality following treatment (11).

Czertak et Hennrikus studied 23 children younger than 6 years with closed femoral shaft fracture treated by early spica cast. Average shortening of the fracture at the time of cast removal was 1 cm (range, 0.1-2.1 cm). Final patient examinations were performed 18-24 months after the fracture. Overgrowth averaged 1.1 cm in the femur (range, 0.5-1.9 cm) and 0.4 cm (0-0.7 cm) in the tibia. Limb lengths in each patient were within 1 cm of the contralateral limb when measured by scanogram and by blocks (12). Thomson et al. reviewed 100 children, ages 2 to 10 years, treated by spica cast. Eighty-one (81%) had an acceptable outcome and 19 (19%) had an unacceptable outcome by the definition of more than 25 mm fracture fragment overlapping following treatment (13).

Anastasopoulos et al. reviewed efficacy of flexible intramedullary (IM) nails as a fixation device of paediatric femoral shaft fractures. A total of 36 children with 37 closed fractures were treated by this method. The patients ranged in age from 7.2 to 13.5 years and the mean follow-up was 25.5 months. Leg-length discrepancy was assessed clinically and radiographically when needed. A total of 50% of the children had a leg-length inequality but none of them complained of a functional problem (14).

In this study, we assessed limb length discrepancy by radiological methods. Some authors assessed LLD by radiologic (15, 16) and others by clinical assessment (17, 18). This difference may cause to different results. Wright JG in systematic review concluded that surgical treatment has a higher rate of overgrowth length compared to non surgical treatment (19).

In our study, results are similar to Holschneider et Kaufner (11). Regarding to treatment modalities, patients were divided in two groups. In Fass et al. (20), Hehl et al. (21), and Wessel and Syfriedt (22) studies, sex factors, type of fracture, closed or open fractures were not studied. In current study, sex, type of fracture, open or closed fractures were studied. There is no significant relationship between postoperative difference in length and mentioned factors. Sex factors did not have a role in postoperative length (20, 21, 22). Right or left side involvement did not play a role in postoperative length change. This is similar to Kohan and Cummings (23) and Meals (24).

Some study recommended surgical treatment for femoral shaft fracture because it allows early mobilization. They recommend that to avoid leg discrepancy that good anatomical reduction must be done as early as possible with surgical treatment (25).

Overgrowth after femoral fracture may be due to overstimulation of growth plate (26). The least overgrowth was seen in non-surgical procedure. In surgical procedure, stimulation of growth plate may be due to insertion of nails and screw.

We have some limitation in this study. We did not study radiological changes in cases with LLD. Another limitation is low sample size in cases with flexible IMN and Rigid IMN + casting methods. This limitation was due to some economic problem in our patients. But in this study, we compared 4 groups of treatment. Most of published manuscript, studied one group or compared two groups of cases (15, 17, 27). In patients underwent ORIF with screw and plate fixation, there was significant difference between type A1 and A3 for post operative lower limb discrepancy. In patients treated by spica casting and closed reduction, type A2 patients had more LLD compared to type A1 cases. In this study we found that in addition to surgical and non-surgical treatment, type of fracture may play a role in postoperative LLD. We recommend using treatment procedures with least effect on postoperative length in fracture with most changes in length.
REFERENCES


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