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Outcomes of Closed Reduction and Internal Fixation (CRIF) by Cannulated Cancellous Hip Screw in Transcervical Fracture Neck of Femur in Children

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Abstract **Original Research Article**

Introduction: Fracture of the neck of the femur is one of the most common and difficult problems all over the world, for all ages. As the femur is the weight-bearing bone in the lower limbs, fracture of the neck femur creates severe problems like shortening, limping, and a painful unstable hip. The incidence of pediatric neck fractures is highest in children above the age of eleven. The most common cause is high-energy trauma such as motor vehicle accidents and falls from height, also osteogenesis imperfecta, and myelomeningocele. This study aimed to analyze the outcomes of closed reduction and internal fixation (CRIF) by the cannulated cancellous hip screw in the transcervical fracture neck of the femur in children. ***Methods:*** This prospective interventional study was conducted at the National Institute of Traumatology & Orthopedic Rehabilitation (NITOR), Dhaka, from July 2011 to June 2013. A total of 16 patients were selected for this study as per inclusion criteria. All statistical analysis of different variables was analyzed according to the standard statistical method by using SPSS. ***Result:*** In this study, the age of the patients ranged from 5-18 years with an average age of 11.25 years. The majority of the patients (56.25%) belonged to the age group 10-14 years, followed by 31.25% in the age group 5-9 years, and the rest 12.50% in the 15-18 years age group. Out of 16 patients, 10 patients (62.50%) were male and 06 patients (37.50%) were female. In the present study, the anatomical reduction was achieved in 07 (43.75%), the acceptable reduction was achieved in 05 (31.25%), and the unacceptable reduction in 04 (25.0%). The average time interval between injury and operation was 7.3 days, out of 16 study cases, 10 cases operated within 7 days of which 9 were united (90.0%), and 6 cases were operated after 7 days, of which 4 (66.66%) were united. Out of 16 patients, 12 (75.0%) regained full range of hip movement and 04 (25.0%) patients had limited range of motion. In this study, 12 patients (75%) achieved the union of fracture within 24 weeks (06 patients in 6 Weeks, 04 patients in 12 Weeks, and 02 patients in 24 Weeks). Out of 16 patients, the union was achieved in 75.0% of cases and nonunion in 25.0% percent cases. According to Ratliff's Assessment of Results, out of 16 patients, 08 (50%) cases had good results, 04 (25%) had fair results, and 04 (25%) had poor results. The functional outcome showed that satisfactory (good & fair) results were achieved in 12 (75%) cases and unsatisfactory (poor) results in 04 (25%) cases. ***Conclusion:*** Cancellous cannulated hip screws are an effective method for the treatment of transcervical fracture neck of femur in children and give a good outcome.

Keywords: Fracture, CRIF, Femur, Hip Screw.

INTRODUCTION

Fracture of the neck of the femur in normal children is rare but is known to be associated with a high rate of complications, especially femoral head necrosis. When it occurs, it is usually due to severe high-velocity trauma or a pathological process affecting the bone [1]. Femoral neck fractures are associated with others injuries such as pelvic fracture, fracture of the ipsilateral and contralateral distal radius, and facial injuries. The fracture can also occur spontaneously after low-energy trauma or through proximal femoral bone cysts as

described by another author [2]. In the early 1800s, femoral neck fractures were treated with bed rest and traction. This leads to a high rate of avascular necrosis, nonunion, and death. The use of multiple pins popularized by Knowles in the 1930s increased the stabilization of intracapsular fractures and helped with avascular necrosis and nonunion [3]. Delbets classification was described in 1982 and popularized in 1929 by Colonna which described four different types of proximal femoral fractures in children [4]. A type 1 fracture is a trans-epiphysial fracture with or without dislocation of the head; Type 2 is described as a transcervical fracture. This type represents the largest group of fractures, Type 3 in Delbets classification presents as a cervico- trochanteric fracture, and Type 4 is an intertrochanteric hip fracture [5]. Current concepts of treatment of fracture neck femur in children for Type-I, Gentle close reduction and fixation with smooth pins (in younger children) or with cannulated screws (in adolescents). Type-II fractures should be treated with anatomical reduction and stable fixation to minimize the risk of late complications. Internal fixation of all type-II fractures, with avoidance of penetration of the physis with the pin as possible, has been recommended by most authors. Cannulated screws should be inserted short of the physis if possible; however, this is not always possible, and the emphasis should be on the achievement of stable fixation of the fracture even if physeal penetration is necessary. Type-III non-displaced fractures may be treated with an abduction spica cast after a period of traction, displaced type-III fractures should be treated with anatomical closed reduction and internal fixation. Type-IV both undisplaced and displaced fractures are treated with closed reduction, traction, and immobilization in a spica cast [6]. Multiple pins fixation of femoral neck fractures was advanced with the introduction of cannulated pins in the early 1970s and was further advanced with the use of a larger guidewire and self- tapping screws in the late 1970s by Kile [7]. For displaced fractures of the hip in children, a standard protocol has been an early anatomical closed reduction, internal fixation, and immobilization in a cast gave reduced rates of complications. Type-I has the highest avascular necrosis risk, while type IV has the lowest [8]. The most widely used methods now a day's advocate treating fracture neck femur in children with anatomical closed reduction and internal fixation by cannulated cancellous screws which give compression and rigid fixation at the fracture site and thus improve the method of primary treatment of fracture neck femur in children. So, this study aimed to analyze the outcomes of closed reduction and internal fixation (CRIF) by the cannulated cancellous hip screw in the transcervical fracture neck of the femur in children.

OBJECTIVE

General Objective

- To evaluate the functional outcome of closed reduction and internal fixation (CRIF) by cannulated cancellous hip screws of transcervical fracture neck fracture in children.

Specific Objectives

- To evaluate the results and outcomes with regard to-
  - Time taken for the union of fractures.
  - To assess functional clinical outcomes (According to Ratliff Assessment of Results).

METHODS

This prospective interventional study was conducted at National Institute of Traumatology & Orthopedic Rehabilitation (NITOR), Dhaka, from July 2011 to June 2013. A total of 16 patients were selected for this study purpose as per inclusion criteria. All subjects underwent proper surgical procedures after obtaining informed written consent. A pre-designed data collection sheet was used to collect data containing the history & physical examination findings of the patient, operative procedure & follow-up criteria. Every patient was radiologically investigated and they were followed up regularly for up to 6 to 12 months. All statistical analysis of different variables was analyzed according to the standard statistical method by using the SPSS method. All data were kept confidential and used only for this study purpose. Ethical clearance was obtained from Ethical Review Committee, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka, Bangladesh.

Inclusion Criteria

- Patients with fracture neck of femur.
- Patients of 5 to 18 years of age of both sexes.
- Patients with a fresh fracture within 3 weeks of injury.
- Patients who had closed fractures.
- Patients who had given consent to participate in the study.

Exclusion Criteria

- Patients above 18 years of age.
- Patients having fractures of more than 3 weeks.
- Patients who had multiple fractures.
- Patients who had open fractures.
- Patients having pathological fractures.
- Patients who did not give consent to participate in the study.

RESULTS

In this study, the age of the patients ranged from 5-18 years with an average age of 11.25 years. The majority of the patients (56.25%) belonged to the age group 10-14 years, followed by 31.25% in the age group 5-9 years, and the rest 12.50% in the 15-18 years age group [Table 1]. Out of 16 patients, 10 patients (62.50%) were male and 06 patients (37.50%) were female [Figure 1]. In the present study, the anatomical reduction was achieved in 07 (43.75%), the acceptable reduction was achieved in 05 (31.25%), and the unacceptable reduction

in 04 (25.0%) [Table 2]. The average time interval between injury and operation was 7.3 days, out of 16 study cases, 10 cases operated within 7 days of which 9 were united (90.0%), and 6 cases were operated after 7 days, of which 4 (66.66%) were united [Table 3]. Out of 16 patients, 12 (75.0%) regained full range of hip movement and 04 (25.0%) patients had limited range of motion [Table 4]. In this study, 12 patients (75%) achieved the union of fracture within 24 weeks (06 patients in 6 Weeks, 04 patients in 12 Weeks, and 02 patients in 24 Weeks). [Figure 2] Out of 16 patients, the union was achieved in 75.0% of cases and nonunion in 25.0% percent cases [Table 5]. The criteria for functional outcome described by Ratliff's Assessments of Results. (Ratliff, 1960) was shown in a table [Table 6]. According to Ratliff's Assessment of Results, out of 16 patients, 08 (50%) cases had good results, 04 (25%) had fair results, and 04 (25%) had poor results [Table 7]. Functional outcome showed that satisfactory (good & fair) results were achieved in 12 (75%) cases and unsatisfactory (poor) results in 04 (25%) cases [Table 8].

Table 1: Distribution of patients according to age (N=16)

Age group (years)	N	%	Mean ± SD
05-09	5	31.25	11.25±2.38
10-14	9	56.25	
15-18	2	12.50	
Total	**16**	**100.0**	

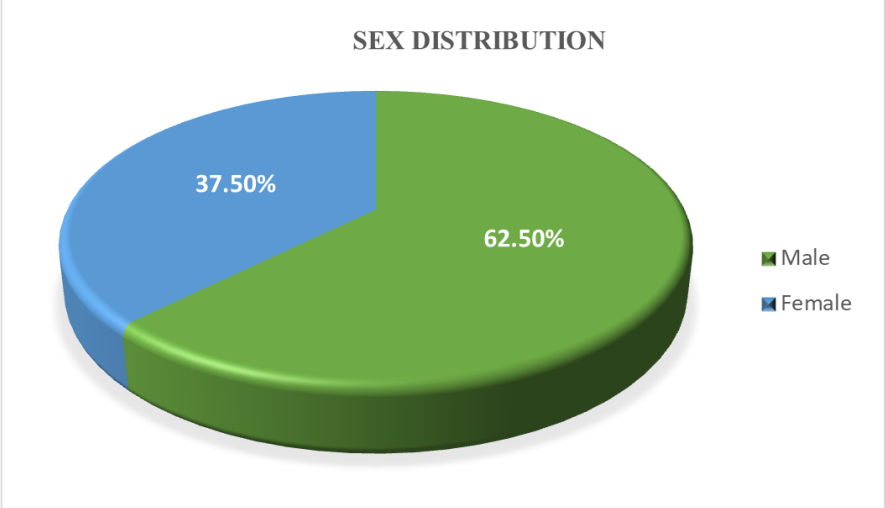

Figure 1: Distribution of respondents according to sex (N=16)

Table 2: Distribution of patients by the quality of reduction (N=16)

Quality of reduction	N	%
Anatomical reduction (no displacement or angular deformity)	07	43.75
Acceptable reduction (displacement of<2mm or angular deformity within 20 degrees)	05	31.25
Unacceptable reduction (displacement of>2mm or angular deformity>20 degrees)	04	25.0
Total	**16**	**100.0**

Table 3: Distribution of subjects according to the relationship between union and duration of injury (N=16)

Duration of injury (days)	N	Union achieved in Percent
01-07	10	09 (90.0%)
08-21	06	04 (66.66%)

Table 4: Distribution of patients by hip movement at the end of follow-up (N=16)

Mobility	N	%
Full range of motion	12	75.0
Limited range of motion	04	25.0
Total	**16**	**100.0**

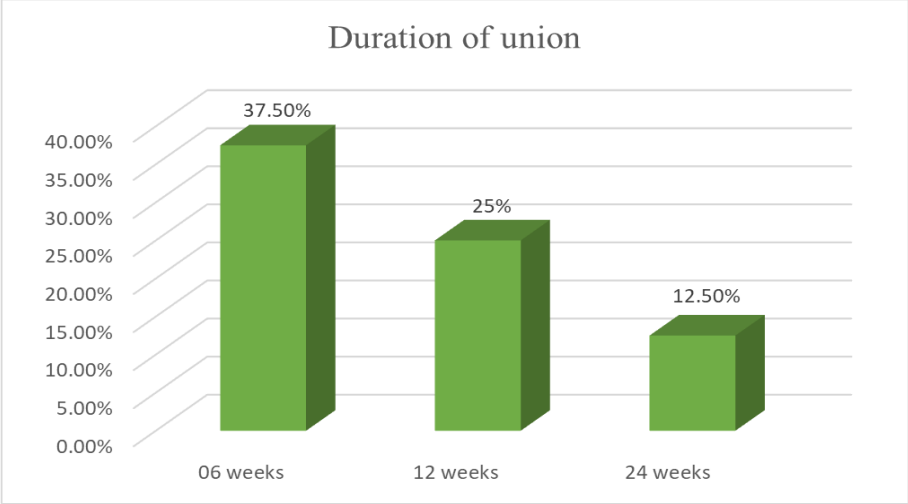

Figure 2: Distribution of patients on the duration of the union of fracture (N=16)

Table 5: Distribution of patients according to results of fracture union (N=16)

Results	N	%
Union	12	75.0
Nonunion	04	25.0

Table 6: The criteria for functional outcome described by Ratliff's Assessments of Results (Ratliff, 1960)

Traits	Good	Fair	Poor
Pain	None or patients ignore it	Occasional	Disabling
Movement	full or only terminal restriction	Greater than 50 percent	Less than 50 percent
Activity	Normal or patient avoid games	Normal or patient avoids game	Restricted
Roentgenographic indications	Normal or some deformity of Femoral neck.	Severe deformity of femoral neck mild avascular necrosis	Severe avascular necrosis, degenerative arthritis, arthrodesis

Table 7: Distribution of the patients by Ratliff's Assessment of Results (N=16)

Results	N	%
Good	08	50.0
Fair	04	25.0
Poor	04	25.0
Total	**16**	**100.0**

Table 8: Distribution of patients according to functional outcome of results (N=16)

Functional outcome	N	%
Satisfactory	12	75.0
Unsatisfactory	04	25.0
Total	**16**	**100.0**

DISCUSSION

The average age of the patient was 11.25 years ranging from 5 to 18 years which was quite relatable to another study where the mean age was 11 years [9]. In this study, the average time interval between injury and operation was 7.3 days which was relatable to another study [10]. In this series, all the patients were treated by close reduction and internal fixation with 4mm & 6.5 mm cannulated cancellous hip screws followed by a hip spica cast. Out of 16 cases, 07 (43.75%) had an anatomical reduction, 05 (31.25%) had an acceptable reduction and 04 (25.0%) had an unacceptable reduction with compare to another study where out of 12 cases, 03 (25%) had an anatomical reduction, 08 (66.7%) had an acceptable reduction and 01 (8.3%) unacceptable reduction [11]. In this study, all patients remained non-weight- bearing for a minimum of six weeks followed by progressive weight-bearing with crutch

further six weeks and full weight after 12 weeks. In this series, hip spica were applied to all the patients below the age of 12 years (68.75%), and after 12 years hip spica were not applied (31.75%). The rate of nonunion in this study was 25.0% with compare to other studies; such as 10.0% nonunion by use of Knowles pin in a study, 6.5% nonunion by Knowles pin in another study, 7.0% nonunion by cannulated screws in a study, 14% nonunion by cannulated screws in another study. This difference may be explained by fracture type, poor reduction, inadequate internal fixation, and breakage of the screw [12, 5, 6] In this series, good results were achieved in 8 Cases (50%), fair in 4 cases (25%) and poor results in 4 cases (25%). Poor result due to fracture was displaced, unacceptable reduction, and delayed fixation. So, this series showed a 75% satisfactory outcome with a comparison of a satisfactory outcome according to Ratliff's radiological and clinical criteria obtained in 72% and 75% satisfactory outcomes in other studies [13, 14] A similar picture was also seen in a study conducted by another author where a satisfactory result was seen in 75% of cases [15]. In this series, cannulated 4.0- millimeter screws, in children; and cannulated 6.5-millimeter screws, in adolescents were used. The placement of the screws was parallel in the center of the neck in AP view but straddling the anterior-posterior margins of the terminal neck in the lateral x-ray. In the case of three screws, an additional screw skirts the inferior cortex of the neck but remains centered in the lateral. The use of guide wires during the insertion of the screw prevents the rotation of the proximal fragment. Screws should be parallel and the lower one preferred should be over the inferior cortex. The most important factor in the success of the treatment of the young patient with a femoral neck fracture was an immediate anatomic reduction with stable internal fixation.

Limitations of the Study

The study was conducted in a single hospital with a small sample size, with a short follow-up period. So, the results may not represent the whole community.

CONCLUSION

It can be concluded that in the treatment of transcervical fracture neck of the femur in children, close reduction and internal fixation (CRIF) by cannulated cancellous is the preferred method.

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Conflict of Interest: None declared.

Ethical Approval: The study was approved by the Institutional Ethics Committee.

RECOMMENDATION

Fracture neck femur in children is rare and the importance is related not to the frequency of the injury but to the frequency of complications and requires careful attention. A fracture of the neck of the femur is an orthopedic emergency. Every medical personnel should be acquainted with its immediate primary management. Moreover, large- scale studies involving multiple centers with longer follow-ups are an essential requirement for an optimum outcome comparison.

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