ORIGINAL ARTICLE

To Compare the Functional Outcome of Locking Plate Fixation versus External Fixation in open fracture of shaft of femur (Gustillo type IIIa) in 8-12 years old children

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ABSTRACT

Aim: To compare the functional outcome of locking plate fixation versus external fixation in open- Gustillo type IIIa femoral shaft fractures in children of eight to twelve years of age.

Methods: This randomized controlled trail was done using simple random sampling technique at emergency and indoor of the department of Orthopedic Surgery and Traumatology Unit-I, King Edward Medical University / Mayo Hospital, Lahore from 25th April 2016 to 24th April 2017. We included 60 patients age 8-12 years of either gender, presented with open Gustillo Anderson type IIIa non-comminuted fracture femur diagnosed on history, clinical examination and radiographs. We recorded wound and fracture healing, infective process and reduction of the fracture were compared in both groups.

Results: With locking plate fixation technique, the union rate was 96.67%, while with external technique; the union rate was 90.0%. In Group-A, infection rate was 3.33%, while 10% infection was occurred in Group-B patients.

Conclusion: Outcome of fixation of open fractures - Gustillo Type - IIIa of shaft of femur in terms of clinical and radiological evaluation with locking plate is better than external fixation in 8-12 years old children.

Key Words: Shaft of Femur, Open Fracture, Locking Plate, External Fixation, Pediatrics.

INTRODUCTION

Open fracture of the femoral shaft is common injuries presented in pediatric age group. Annual incidence is around 19 fractures per 100,000 children in US[1,4]. Femoral shaft fractures account for almost up to 62 percent of all femoral fractures[3]. Data reported high rate of complication and associated injuries in open femoral shaft fractures[2, 4–8.] and its proportion varies nature and intensity of the sustained trauma[9]. The management of open femoral fractures in children is very challenging. Orthopedic surgical measures are usually warranted in instances of multiple bone fractures, open fractures, compartment syndrome, shortening, angulation or rotation at the fracture ends of bone rendering the surgery essential[1].

The exact treatment of such fractures remains controversial[10]. Fixation of the open femoral shaft fractures with external fixator or locked plate are the ideal surgical treatment alternatives accessible where there is an indication of surgical intervention[1]. The external fixator has schanz screws fixed with external bars attached through clamps to stabilize the fractures lying outside the skin[2]. Locking plate has percutaneously passed locking screws, locked to the plate passed through a small distal incision[3].

In both techniques, damage to blood supply of the bone is not compromised as the periosteum is not being compressed. Similarly, the callus is formed in both techniques by secondary healing of bone. Although these two techniques yield same mechanism of the osteosynthesis, they are different in many aspects with different pros and cons in the form of cost, technical aspects and patient's view point[4]. External fixation required long hospital stay but is more cumbersome to patient than the locking plate although it can be very effective in maintaining fracture reduction so it has theoretical advantage of reduced rates of malunion[12,13]. At times staged protocol is adopted, i.e., external fixation is undertaken for a short period of time for a particular reason most commonly contaminated wound. Once the wound has healed or clean and tissue equilibrium has been achieved, for management the bone is internally fixed[5].

A randomized control trial of femoral shaft fractures fixed with locking plate in forty-one patients of pediatric age group revealing complete clinical and radiological union achieved in 85% of cases with complication rate of 12% (re-fracture after implants removal)[6]. One more study of thirty-two femoral fractures fixed with locking plate in pediatric and adolescence age showed success rate of 100% evident by complete radiological healing[7]. As there are more chances of angular deformity, there is increasing trend towards surgical management of fractures of young children. Allowable angular deformity in femoral fractures of children must not be more than ten degrees forward/backward or five degrees medial/lateral because any angulations of the femur are directly related with arthritis of the knee-joint[8].

The data regarding randomized controlled trials on comparison of fixation of the open femoral shaft fractures of eight to twelve years old children with either external fixator or locking plate is insufficient. The guidelines of high-income countries can't be applied to developing countries

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like ours that is why it is extremely important to develop a research in our settings along with guidelines according to our own circumstances and affordability. With the help of the study, there is going to be a great help to develop an evidence for supporting the best surgical option for management of open femoral fractures in children along with comparative results.

METHODOLOGY

This randomized controlled trail was done using simple random sampling technique at emergency and indoor of the department of Orthopedic Surgery and Traumatology Unit-I, King Edward Medical University / Mayo Hospital, Lahore from 25th April 2016 to 24th April 2017. We included 60 patients age 8-12 years of either gender, presented with open Gustillo Anderson type IIIa non-comminuted fracture femur diagnosed on history, clinical examination and radiographs. Exclusion criteria was associated injuries including head injury, chest and abdominal trauma, multiple fractures, vascular injuries, shock, immunocompromised patients, type I diabetes mellitus, steroids dependent juvenile rheumatoid arthritis chest deformity, low serum calcium, high serum alkaline phosphatase and previous surgery for similar fracture diagnosed on history, clinical examination, baseline, serum calcium, phosphate, alkaline phosphatase, BSR and radiographs.

After the approved from ethical review board of our institution, consent was taken from all participants who were enrolled after explaining the risk-benefit ratio of both procedures. Patients were randomly divided into group-A and group-B by lottery method. All patients in group-A were treated with locking plate fixation and group-B were treated with external fixation.

Wound was debrided and washed with normal saline 0.9%. Patients were made ready and back-slab above knee was applied for skeletal stabilization. All patients were operated under general anesthesia by a single surgical team. First generation cephalosporins were injected after checking their sensitivity as pre-operative and continued post operatively for at least 7 days. Follow up at 6th postoperative day, 12th week and 24th weeks postoperatively for wound and fracture healing, infective process and reduction of the fracture were compared in both groups. After six weeks, weight bearing started partially when there was radiologic evidence of callus. Full weight bearing was started when appropriate and noted.

The data was analyzed by using SPSS v23.0. Chi-square analysis or the Fisher exact, where required, applied for qualitative variables (gender, presence or absence of infection and union). A p-value of < 0.05 was considered as significant. Quantitative variables like age was described as means.

RESULTS

Among the total 60-patients, 22(73.30%) were males and 08 (26.70%) were females in Group-A, while 23(76.67%) were males and 7(23.33%) were females in Group-B. Among these patients, 4(13.33%) were 08 years old, while 9(30%), 9(30%), 5(16.67%) and 3(10%) were 9, 10, 11 and 12 years old respectively in Group-A. Most 8(26.67%) were 08 years old, while 10(33.33%), 5(16.67%), 3(10%) and 4(13.33%) were 09, 10, 11 and 12 years old respectively in Group-B. Mean age of the patients was 9.8±1.19 with 8 and 12 as minimum and maximum ages in Group-A. Similarly, mean age of the patients was 9.5±1.36 with 8 and 12 as minimum and maximum ages in Group-B. In Group-A, infection rate was 3.33%, while infection occurred in Group-B patients was 10%. With locking plate fixation technique, the union rate was 96.67%, while with external fixation technique; union rate was 90% (Table 1).

In Group-A, patients with Right femur were 14(46.67%) and left femur was in 16(53.33%), while in Group-B, Right femur fracture was in 15(50%) patients and Left femur Fracture was also in 15(50%). By applying Chi-Square test, it was concluded that, there was significant difference between both techniques for shaft of femur fractures union (p<0.001) (Table 2).

Table 1: Frequency distribution of different variables

Groups	Union		Total
	Yes	No	
A	29 (96.7%)	01 (3.2%)	30 (100%)
B	27 (90.0%)	03 (10%)	30 (100%)
Total	56 (93.35%)	4 (6.65%)	60 (100%)
Infection			
A	1(3.2%)	29 (96.7%)	30(100%)
B	03 (10.0%)	27 (90%)	30(100%)
Total	2 (6.65%)	56(92.35%)	60 (100%)
Site of Fracture			
A)	14 (46.7%)	16 (53.3%)	30(100%)
B	15 (50%)	15 (50%)	30(100%)
Total	29 (48.35%)	31(51.65%)	60(100%)

Table-2: Comparison between Groups and Union

Groups	Union		Total
	Yes	No	
A (Locking Plate Fixation)	29 (96.7%)	01(3.2%)	29 (96.7%)
B (External Fixation)	27 (90%)	03 (10%)	27 (90%)
Total	56(93.35%)	4 (6.65%)	56(93.35%)

P value 0.001

DISCUSSION

Locking plate fixation for shaft of femur fractures has been found to associated with higher union rate [7,8] utility of Locking plate in higher energy trauma or open fracture can result in reduced cortical blood flow, more endosteal necrosis, and higher intra-compartment pressures along with chances of developing the infection[3,15, 16]. Maintaining the appropriate fracture reduction with unstable segments is technically demanding whereby additional plates, locking screws, or open placement of a bone reduction clamp/bone holder to hold the segment are required during fracture fixation[11,12].

Proper initial anatomical reduction is very essential having direct relationship with much quicker healing time irrespective of the adopted technique of fixation[17]. Secondary reduction cannot be achieved due to scarring and excessive formation of callus in this age group. After proper debridement of dead and necrosed bone and soft tissue depending upon the protocol, the reduction is achieved via a closed and minimally invasive technique without much soft stripping through the traumatic wound or small incision. If indicated, the fractures can be stabilized with help of screws under image intensification.

External fixators have been changed according to latest trauma treatment for temporary or permanent management for higher energy trauma. The external fixator is being used for the initial treatment of multiple open fractures successfully to provide appropriate skeletal stability and proper access for proper wound management.

External fixator (uni-planner, bi-planner or multi-planner-illizarov) is highly unique and reproducible fixation device [10,18] for maintaining the fractures, eliminates the requirement of hardware thus providing stable support for soft tissue reconstruction. Primary problem of this is the malunion or nonunion and permanent postoperative disabilities. Also it has been found to be related with the pin tract infections or loosening of the fixator as well as reduction of the fracture, neurovascular injury, damage to soft tissue, intra-articular injury, permanent pain and refractures after removal of fixator[19].

Our study revealed that 96.67% fractures treated with locking plate have been united when it was compared with a nonunion rate of 10% with external fixator. Robinson and coworkers showed a nonunion rate of 21% for the displaced femoral shaft fractures with external fixator [20]. Brinker et al calculated this data and found nonunion rate from 20% and 33% for displaced, open fractures in young males[21]. Our results are comparable with these outcomes. Malunion was the most common outcome in the non-operative. Patients managed non-operatively were five times more likely to have symptomatic malunion. Our results compare well with the study by Nowak et al, in which 46% of patients with displaced shaft of femur fractures experienced symptomatic outcomes when treated with external fixator[22]. Hill et al published that the outcome with external fixator were unsatisfactory, i.e., outcome rate of 31%[23].

In terms of functional outcome, Constant scores for patients receiving surgery were significantly better at follow up of 3-months; this has previously been shown to be clinically relevant[24].

A recently conducted randomized controlled trial showed that early primary plate fixation of completely displaced shaft of femur fractures results in improved patient-oriented outcomes, improved surgeon-oriented outcomes, earlier return to function, and decreased rates of nonunion and malunion. Malunion and nonunion was the most common in the non-operative group. Our results compare well this study[25].

CONCLUSION

Outcome of fixation of open transverse fractures of shaft of femur (Gustillo Type-IIIa) with locking plate is better than external fixation in 8-12 years old children.

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