

# Comparing Outcomes of Plating versus Flexible Nailing of Fracture Shaft Femur in children: Meta-analysis Study

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## Abstract

**Background:** Femoral diaphyseal fracture especially at the shaft of femur was represented <2 % of all pediatric fractures. The aim of this Meta analysis study is to supply a good idea about the optimal fixation methods for femoral diaphyseal fracture in school age children 5-14y based on the current evidence. **Patients and Methods:** A computerized research was performed in PubMed, Medline, Google scholar and Cochrane Library database to identify the relevant literatures that published until May 2020. By using RevMAN5.4 software the data pooled and analyzed for the meta-analysis. **Results:** the pooled data demonstrated a statistically significant difference  $P$  value < 0.05 in Operative Time (OT), Estimated Blood Loss (EBL) and Union Time (UT). **Conclusion:** According to the collected data from the included studies demonstrated that operative time, estimated blood loss and union time goes in favor to flexible nails. In the other side, using plate fixation is more stable and has lower rate of fracture malalignment more than retrograde flexible nail. So, based on the pooling data results we suggest the use of flexible nails with the stable femoral diaphyseal fractures, due to the minimally invasive technique, early union and weight bearing.

**Keywords:** Femur/Femoral Fractures, Intramedullary Nail, Plate Fixation, Children, Meta-analysis

## Introduction:

Femoral diaphyseal fracture has represented <2 % of all fractures in children. Femoral fractures were occurring mostly at the shaft of femur, which fractures type needing hospital admission (1).

The plate fixation biomechanically is more stable than flexible nails, because of the anatomical fixation which achieved with plate fixation, in opposite to relative fixation and callus formation that achieved with flexible nails (2).

Closed fixation using the flexible intramedullary nail (FIN) is a unique technique of fixation, because it's minimally invasive method with less soft tissue dissection, minimal blood loss and less periosteal damage. FINs also preserving hematoma at the fracture site, which is important for fracture healing and callus formations (3,4).

The most used plates for fixation technique are metallic in origin (stainless steel or

titanium); they have widespread usage due to excellent biomechanical properties of the mentioned metals. Biologically, the used metals have good compatibility to soft tissue and bone without toxic reaction and prevent formation of fluid-filled dead space around the plate, which is good media for bacterial growth and infection. Mechanically, the used metals are corrosion resistance, with sufficient ductility that allows shaping of the implant in many forms (5).

Recently MIPO technique has appeared and gets popularity instead of old traditional ORIF technique, because of lower complications than old one. The idea of MIPO technique: reduction and fixation is done by preserving fracture hematoma and fracture zone is not opened, through indirect maneuver by small skin incision (6).

Therefore, this meta-analysis study is aimed to supply a good idea about the optimal fixation methods for femoral diaphyseal fracture in school age children 5-14y based on the current evidence.

- **Materials and Methods:**

A Computerized research was included the single keyword or in combination: “fracture“femur” “diaphysis/shaft” “children” “plate/plating” “intramedullary” “flexible nail/nailing” and performed on Library database to identify the studies that comparing flexible nails versus plate fixation that published until May 2020.

**Inclusion criteria:**

Studies that comparing flexible nails versus plate fixation, Studies including closed and Gustilo type (1) femoral diaphyseal fracture, Studies in English language, Studies including children age between 4-15 years. While we excluded studies investigating only nail fixation or only plate fixation, review literature, case report.

**Risk of Bias :**

The risk of bias for the 6 prospective studies has evaluated and showed in **Figure (1)**. The assessment for each included study was with the bias risk tool of Cochrane handbook 5.1.0, in which all the seven bias elements were assessed.

**Quality Assessment of the Studies:**

All the included studies were clinical trial studies, which compare plate fixation versus flexible nails for fracture shaft of femur in pediatric. and only three of them were randomized clinical trials RCTs (**Olivo et al. Ahmed et al. and Wang et al.**).

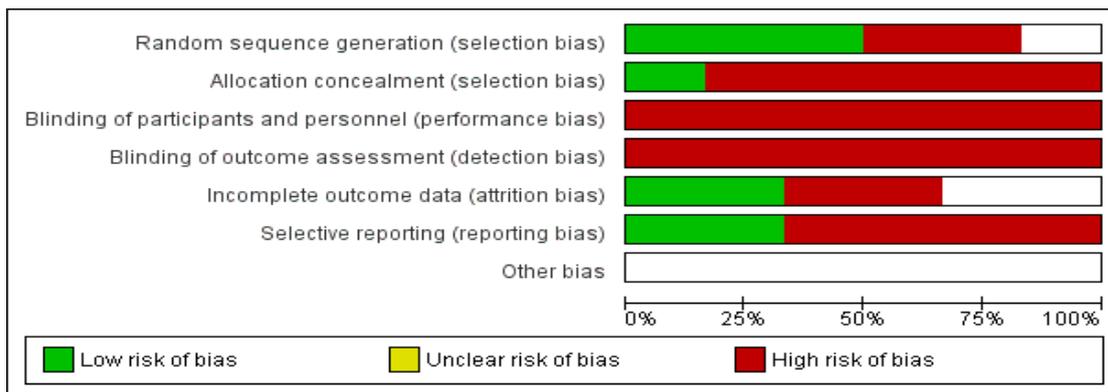


Figure (1): shows Risk of bias in the included study

Results:

After data pooling and analysis the results of each forest plot divided into statistical significant and nonsignificant according to P value measures.

There was a statistically difference in operative time (OT) (Mean Difference MD = -27.32, Confidence Interval CI = -47.20 to -7.43, P value = 0.007) (Figure 2).

There was a statistically difference in estimated blood loss (EBL) (MD = -66.25, CI = -84.42, -48.07, P value = 0.00001) (Figure 3).

There was a statistically difference in union time (UT) (MD= -2.96, CI = -4.49 to -1.44, P value= 0.00001) (Figure 4).

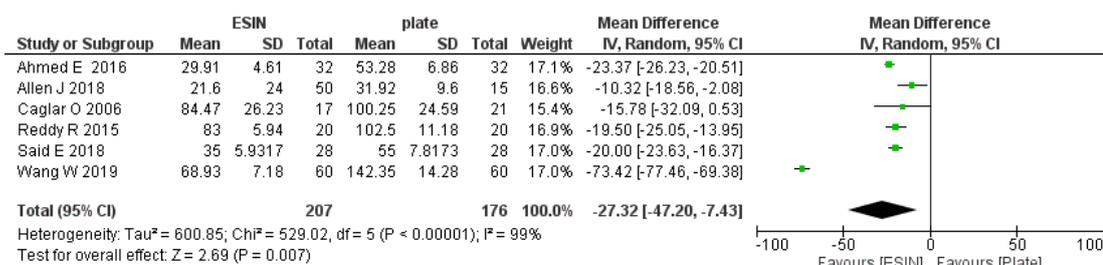


Figure (2): Forest plot shows OT

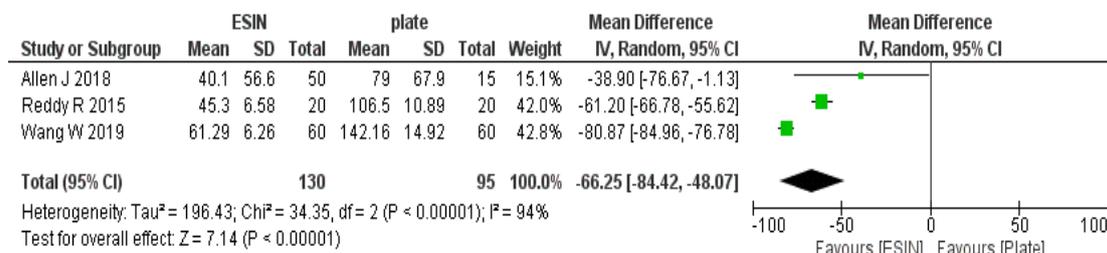
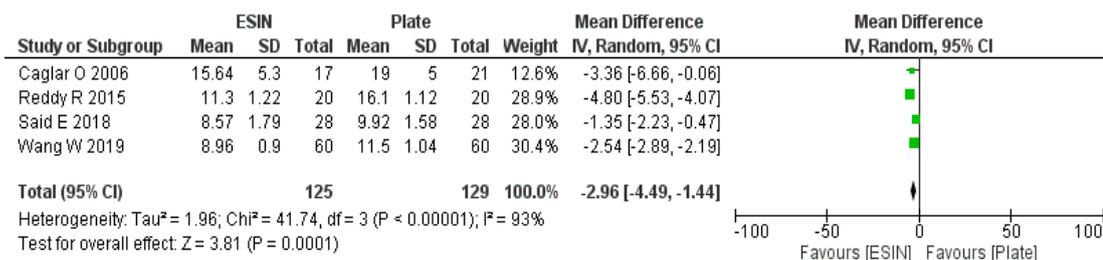


Figure (3): Forest plot shows EBL

1. :



**Figure (4): Forest plot shows UT**

### Discussion:

Femoral shaft fracture in school age children is considered one of the commonest in pediatric patients, but with highly controversial in its management. Either using ESIN or plate fixation is still a point of debate. Meta-analysis of relevant literature is considered one of the highest levels of evidence based medicine concluding by treatment guidance and developing of management protocols (7).

There is general agreement that diaphyseal femoral fracture in children up to 5 years are mostly treated conservatively and rigid intramedullary nail are used in children age 14y and above. Controversial remain the main problem in choosing the best method of fixation for femoral diaphyseal fracture treatment in school age group, where the two methods of treatment are ESIN and plate fixation (8-10).

The purpose of our meta-analysis study is to give a good idea and characteristics about the optimal fixation methods for fracture diaphysis of femur in school age children, which concluded that using of elastic nailing may be optimal in fixation of stable fracture configurations with operative advantages over the plate, while plating had inherited fixation stability in the management of unstable fractures.

Our analysis showed has shown less operative time is less in ESIN than plate fixation with high statistical significant difference reported by [8], [9], [10], [11]–[12](P value 0.007) that is due to less invasive technique of closed reduction internal fixation. Also had less estimated blood loss (EBL) than plate fixation with a highly significant difference reported in three studies [8], [9], [11] of them (P value 0.00001).

The pooled data from these different studies showed high heterogeneity and this may be due to the different protocols and strategies used in management in these patients. Also types of fractures, fracture comminutions and configurations were not clearly identified in these studies except for Ahmed et al.[8], Caglar et al.[11], Reddy et al.[12].

In Abdelgawad and his colleagues reported a retrospective study of 60 femoral fractures fixed with sub muscular plating 40 of 60 was unstable fractures.They reported that fractures healed with no clinically significant malalignment and minimal leg length discrepancy with only 2 implant failure recorded (13) as shown in **Figure (5)**.

Also, Pandey et al., who reported a prospective study of 60 patients were fixed with Flexible Nails According to Flynn criteria score, the study Reported 48 patients with an excellent outcomes 10 patients with good outcomes and only 2 patients with poor outcomes (14) as shown in **Figure (6)**.

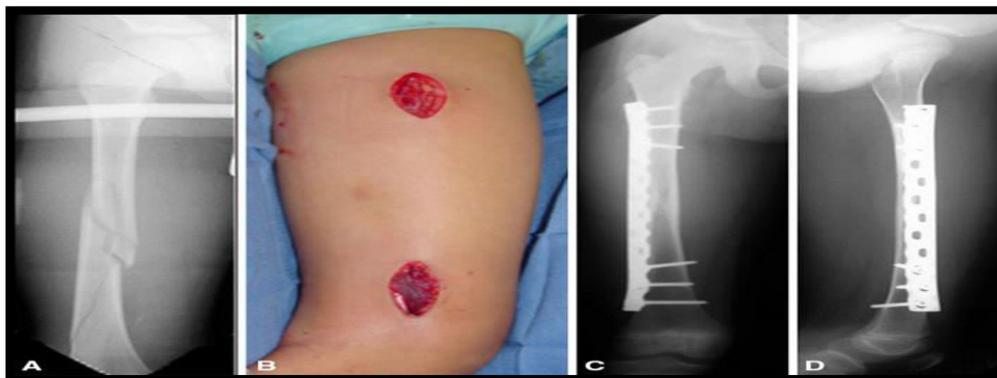


Figure (5): (A) Femur wedge fracture. The patient was 8.2 years old. (B) An intraoperative photograph shows the incisions used to fix the fracture. (C) (D) AP and lateral radiographs show the healed fracture fixed using a 4.5-mm broad stainless steel plate after 16 months, just before plate removal (13).

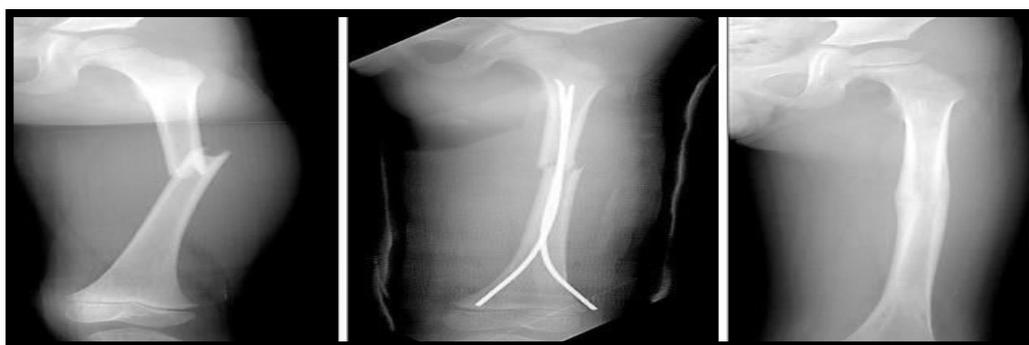


Figure (6): AP view a femur Midshaft transverse fracture treated with Flexible nails (14)

### Study Limitations:

We could not collect many RCTs or studies with appropriate allocation of patients in large sample size studies. The quality of the included study was not remarkably high. Three of the eight studies were randomized clinical trial, two retrospective studies, and the allocation concealment was clarified in one study only. Non-English language literature and unpublished data and studies also considered limitation for the research for eligible studies. This could lead to the missing of a high valuable well randomized controlled trail from being added in this meta-analysis. These limitations must be considered in the following upcoming research and the investigators must take it in account to overcome these limitations in upcoming studies. This can be achieved by organizing well randomized controlled studies including large number of patients to

get strong evidence of the benefits of both techniques, and develop treatment guidelines for femoral shaft fracture in the pediatric patients.

### Conclusion:

It could be concluded that plate fixation is more stable than flexible nails. So, based on the pooling data results we propose the use of flexible nails with the stable fractures, due to the minimally invasive technique, early union and weight bearing. And only use of plates for the unstable fractures due to the rigid fixation.

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