

# Comparison of Clinical Outcomes of Flexible Intramedullary Nailing (FIN) with External Fixation in Pediatric Open Tibial Fractures

MALIK MUHAMMAD YASIN AWAN<sup>1</sup>, MUDASSAR NAZAR<sup>2</sup>, ABDUL QAYYUM BAIG<sup>3</sup>, RIZWAN ANWAR<sup>4</sup>, MUHAMMAD ABDUL HANAN<sup>5</sup>, OMER FAROOQ TANVEER<sup>6</sup>

<sup>1</sup>Associate Professor of Orthopedics, Sahara Medical College, Narowal.

<sup>2</sup>Assistant Professor of Orthopedics, Islam Medical College Sialkot.

<sup>3</sup>District Orthopaedic surgeon, DHQ Hospital Okara.

<sup>4</sup>Assistant Professor of Orthopedics, Islam Medical College Sialkot.

<sup>5</sup>Associate Professor, Khawaja Muhammad Safdar Medical College, Sialkot.

<sup>6</sup>Assistant Professor, Khawaja Muhammad Safdar Medical College, Sialkot.

Correspondence to: Mudassar Nazar, Email: [drqmudassar@gmail.com](mailto:drqmudassar@gmail.com), Cell: +92 312 4407004

## ABSTRACT

**Objective:** To compare the clinical outcome of flexible intramedullary nailing (FIN) with external fixator in pediatric open tibial fractures.

**Subjects and Methods:** In this randomized comparative study, 80 children having age 5 year to 14 years who presented with open tibial fractures were included. The study was conducted from June-2020 to June-2021 in Islam Hospital Sialkot and Allama Iqbal Memorial Hospital Sialkot. Patients were divided into two equal groups. Group A: underwent external fixation and group B: underwent flexible intramedullary nailing for the surgical management of tibial fractures. Frequency of infections surrounding pins, painful bursitis and re fracture rate within 3 months after surgery was recorded.

**Results:** The mean age of children was  $8.42 \pm 3.82$  years in external fixator group versus  $8.40 \pm 4.0$  years in FIN group (p-value 0.97). Infection-surrounding pins occurred in 9 (22.5%) children were belonging to external fixator group and 01 (2.5%) children was belonging to FIN group (p-value 0.007). Refracture occurred in 6 (15.0%) patients in external fixator group and in no (0.0%) children in FIN group (p-value 0.01). Painful bursitis occurred 2 (5.0%) patient was in external fixator group and in 13 (32.5%) in FIN group (p-value 0.002).

**Conclusion:** Clinical outcome is better in patients treated with FIN as compared to the external fixator for the treatment of pediatric open tibial shaft fractures.

**Keywords:** Flexible intramedullary nails, External fixator, Tibial fractures.

## INTRODUCTION

Tibial fractures are the third commonest long-bone fractures after fore-arm and femoral fractures.<sup>1</sup> Open tibial fractures are common presentation of orthopedic trauma in emergency departments.<sup>2</sup> Nearly 50% of these fractures occur in distal tibia in pediatric population, the least common are fractures of proximal part of tibia<sup>1</sup>. In skeletally immature patients, many of tibial fractures can be treated conservatively, but open fractures require special consideration because the selected treatment methodology can affect the future of a child.<sup>3, 4</sup>

Because of sudden rise in road traffic accidents and high energy injuries there is a need to look for more efficient and faster methods of bone fixation.<sup>5</sup> For extensive trauma involving extensive soft tissue injury the successful treatment is external fixation.<sup>6</sup> Since the 1980s flexible intramedullary nails (FIN) have also been used for the management of pediatric tibial fractures.<sup>7</sup> The main advantages of using flexible nailing are; short-term immobilization, early return of joint motion, shorter hospitalization and low cost.<sup>8-9</sup> External fixation is a percutaneous technique of immobilization of bone, easily applicable, frame-adjustable and is associated with minimum blood loss.<sup>10</sup> However external fixator is associated with risks of complications e.g. pin tract infections, re-fracture and the scar formation where the pins are located.<sup>11</sup>

Both these procedures are routinely used in our setup for tibial fractures. Therefore, we planned to conduct this study to compare the outcomes of external fixator versus

flexible intramedullary nails regarding their complications. The results of this study will help us to adopt a better treatment modality i.e. intramedullary nailing or external fixator as 1<sup>st</sup> line choice for our patients in future.

## MATERIALS AND METHODS

A total of 80 children with open tibial fractures were included from June-2020 to June-2021 in the Islam Hospital Sialkot and Allama Iqbal Memorial Hospital Sialkot. Children having age 5 years to 14 years of both genders including male and female having tibial fractures involving proximal part of tibia or distal part of tibia (Gustilo I, II, IIIA & B) were included. Children with lower extremities fractures along with tibia, having systemic and metabolic diseases and those having skeletal congenital diseases were excluded. An informed consent was taken from all patients before including them in this study.

Patients were divided in two equal groups using draw randomization method. Group A: allotted to patients in whom external fixator was to be used and Group B: allotted to the patients in whom flexible intramedullary nailing was to be used.

Both procedures were carried out under standard surgical procedures. In Group A patients, external fixator was used to fix tibial fractures. In Group B patients, FIN were used to fix tibial fractures. Frequency of infections surrounding pins and re fracture rate within 03 months after surgery was recorded. Any post-operative infection documented within one month after principal procedure in the area surrounding the prosthesis was considered as

infection due to complication of the procedure. Pin site infection was defined as any infection within one month around the external fixator pins or flexible intramedullary nails. It was determined by the presence of pus and severe pain i.e. VAS score > 7 around the pins. For re fracture, bone X-rays was done at one month & 3 months after principal procedure to see is there any new fracture in the already affected bone. Painful Bursitis was labelled if there was presence of small, fluid-filled sacs called bursae causing moderate to severe pain during movement of joint.

Data analysis was carried out using SPSS v25.0. Chi-square test was applied to compare infections surrounding pins, painful bursitis and re fracture rate in external fixator and FIN groups taking P-value ≤0.05 as significant.

**RESULTS**

In this study, we included 80 children with tibial fractures and divided them into two equal groups. One group underwent fixation of tibial fracture using external fixator and the other-one using FIN. The mean age of children was 8.42±3.82 years in external fixator group versus 8.40±4.0 years in FIN group (p-value 0.97). There were 20 (50%) male patients in external fixator group versus 24 (60%) in FIN group (p-value 0.37). Location of fracture was proximal in 14 (35%) in external fixator group and 18 (45%) in FIN group (p-value 0.36). The duration of fracture was 21.47±4.18 days in external fixator group versus 21.97±4.12 days in FIN group (p-value 0.59) [Table 1].

Table 1. Baseline Characteristics.

	External Fixator (N=40)	FIN Group (N=40)	P-value
Mean Age	8.42±3.82	8.40±4.0	0.97
Gender			
Male	20 (50%)	24 (60%)	0.37
Female	20 (50%)	16 (40%)	
Fracture Location			
Proximal	14 (35%)	18 (45%)	0.36
Distal	26 (65%)	22 (55%)	
Duration Fractures (Days)	21.47±4.18	21.97±4.12	0.59

Table 2. Comparison of Study Outcomes.

	External Fixator (N=40)	FIN (N=40)	P-value
Infections			
Yes	9 (22.5%)	01 (2.5%)	0.007
No	31 (77.5%)	39 (97.5%)	
Refracture			
Yes	6 (15.0%)	0 (0.0%)	0.01
No	34 (85%)	40 (100%)	
Painful Bursitis			
Yes	2 (5.0%)	13 (32.5%)	0.002
No	38 (95%)	27 (67.5%)	

Infection-surrounding pins occurred in 10 (12.5%) children. Out of these 10, 9 (22.5%) children were belonging to external fixator group and 1 (2.5%) child was belonging to FIN group (p-value 0.007). Re-fracture occurred in 6 (7.5%) children. Re-fracture rate was significantly high in children belonging to external fixator group as compared to the children in FIN. Refracture

occurred in 6 (15.0%) patients in external fixator group and in no (0.0%) children in FIN group (p-value 0.01). Painful bursitis occurred in a total number of 15 (18.8%) patients. Out of these 15, 2 (5.0%) patient was from external fixator group and the other 13 (32.5%) were from FIN group (p-value 0.002) [Table 2].

**DISCUSSION**

Tibial shaft fractures in children are typically simple and may be treated with reduction and casting.<sup>12</sup> Patients with displaced fractures are treated in the operating room under fluoroscopy to speed up the process.<sup>13</sup> Within the past two decades, tibial fractures have been treated non-surgically, and immobilization with a cast has been the conventional therapy.<sup>13,14</sup> Surgical therapy, on the other hand, is advised in situations of multiple injuries, high-energy traumas, open fractures, and compartment syndrome.<sup>15</sup> Although cast immobilization is still the conventional therapy for acceptable tibia fractures, fixation is especially advantageous for children who have had numerous injuries as a result of high-energy trauma. The development of flexible intramedullary nails has resulted in significant advancements in the treatment of children's long-bone fractures, with various benefits mentioned for adopting the procedure to treat long-bone fractures. Intramedullary nails provide for proper alignment and rotation while repairing fractures. They result in micro-motion at the fractured region, strengthening osseous calculus development, and lastly, accelerating the union process, in addition to elasticity and suitable stability. In surgical treatment, a little incision is performed, and the risk of infection is quite low.<sup>16</sup>

In our study, we compared the outcomes of open tibial shaft fractures in terms of infection surrounding pins, painful bursitis and re-fracture rate. In our study, infection surrounding pins occurred in 18.2% patients in external fixator group and in no patient in intramedullary nailing group. Similar to that of infection surrounding pins, re-fracture rate was also high 12.1% in external fixator group as compared to only 0.0% in nailing group. However, frequency of painful bursitis was significantly high in nailing group 24.2% versus only 3.3% in external fixator group.

In a study by Aslani et al. infection surround pins occurred in 22.2% patients in external fixator group and in only 0.0% patients in nailing group. In their study, refracture rate was 22.2% in external fixator group and in no patient in flexible nailing group. Frequency of painful bursitis in their study was 14.2% in flexible intramedullary nailing group and there was no incidence of painful bursitis in external fixation group. In our study, painful bursitis occurred only in 2 patients.<sup>8</sup>

A meta-analysis by Geovannini et al. including five randomized controlled trials involving 239 patients also concluded that the rate of infection surrounding the pins and re-fracture rate is significantly lower in patients treated with flexible intramedullary nails as compared to the patients treated with external fixator.<sup>17</sup>

Another meta-analysis conducted by Fang et al. did not found any significant difference in the incidence of infections and Refracture rate in patients treated by flexible intramedullary nails or external fixator. These authors suggested that both external fixator and flexible

intramedullary nails are equally effective and safe for the treatment of pediatric open tibial fractures.<sup>18</sup>

Indeed, both treatment approaches may be harmed by superficial or deep infection (e.g., pin site infection in external fixators, incision infestation in internal fixators, and significant wound contaminations that might cause subsequent sepsis in all Gustilo grade III open fractures). Making this decision is always a challenge. Pin site care and infection prevention are often top priorities for external fixation patients, who have a high infection prevalence but with low severity.<sup>19</sup> Traditional open reduction and internal fixation procedures need more stringent infection control measures for treating severe open fractures, since the fracture site must be thoroughly exposed and considerable soft tissue dissection is required during the procedure.<sup>20</sup> The risk is significantly higher with intramedullary nailing since the bone cavity is exposed, which might lead to osteomyelitis.<sup>21</sup>

Infection rates are lower, re-fracture rates are lower, care is easier and the scar is more visually acceptable in patients treated with FIN than other fixation procedures. One of the successful approaches to treat open fractures with extensive soft tissue injury is to use an external fixator. It does have some of the drawbacks, such as infection around the pin, the need for care, and re-fracture. In our research, flexible intramedullary nails provided sufficient stability in open fractures. In light of past research, this is a novel finding that might aid in the proper treatment of open fractures. In the treatment of open fractures, the FIN nails approach was shown to be equally successful as an external fixator.

Although external fixation is preferred in open pediatric fractures and severe trauma, flexible intramedullary nailing is a safe and effective alternative.

## CONCLUSION

Clinical outcome is better in patients treated with flexible intramedullary nails as compared to the external fixator for the treatment of pediatric open tibial shaft fractures.

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