Single incision versus two incisions for elastic intramedullary nailing for tibial shaft fractures in children

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Introduction
Tibial shaft fractures are one of the most common long-bone fractures in the pediatric age group. A closed reduction followed by casting is the classical method of treatment in these fractures.the flexible intramedullary may be required in unstable fractures using a 2-incision technique
In this technique with the use of a single medial incision, curves are created with one c shape and the other is s shape,
Patients and Methods
A prospective randomized control study was undertaken to assess the results of elastic stable intramedullary nails (ESIN)in the fixation of tibial shaft fractures in children using a single incision versus two-incision.
Results
30 patients with tibial shaft fractures were treated with EIMN From April 2020 to March 2021 and followed up for 6 months after surgery, the mean age was 8.43 ± 1.55. Group A reported mild postoperative pain, with a significant difference (P value < 0.05) from group B who expressed moderate pain according to FLACCbehavioral Pain Assessment Scale.
Conclusion
This technique has many advantages. as it is a minimally invasive surgery with a short duration of hospitalization. And single incision adds more privilege to be a minimally invasive surgery and the use of a single medial incision puts putting away any possibility of common peroneal nerve injury.

Keywords:
Elastic, nailing, single, tibial shaft fractures

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Introduction

Tibial shaft fractures are one of the most common long-bone fractures in the pediatric age group with an incidence of 15%. These fractures are in the second rank among common pediatric fractures requiring hospitalization after femoral fractures. A closed reduction followed by casting is the classical method of treatment in these fractures. However the surgery is not required in most patients, it may be required in patients with open fractures, polytrauma, neurovascular injury, and unstable fractures causing unaccepted angulation [1].

Surgical treatment can be executed by different fixation methods such as flexible intramedullary nails, plating, or external fixators [2].

Traditionally, the flexible intramedullary nailing approach consists of a 2-incision technique with the passage of one nail medially and the other one laterally. The 2-incision technique permits the application of standard biomechanical principles that stress the importance of 2 nails with opposing curves [3].

In this technique with the use of a single medial incision, curves are created with one c shape and the other is s shape, resulting in creating the apex of each curve located at the fracture site giving the 3-point fixation needed to achieve the needed stability.

Patients and methods

A prospective randomized control study was undertaken to assess the results of elastic stable intramedullary nails (ESIN)in the fixation of tibial shaft fractures in children using a single incision versus two-incision when applying. From April 2020 to March 2021, 30 patients were treated with EIMN after approval of the ethical committee orthopedic department faculty of Medicine at Helwan University. All cases were followed up for 6 months after surgery.

Patients' ages ranged from 6 to 12 years old, the mean age was 8.43 ± 1.55, 21 patients were male and 9 were female.

Patients were divided into two groups group A treated by single entry and group B treated by double entry, all cases meet the inclusion criteria.

Methods

All patients were subjected to both clinical and radiological examination on admission to the hospital with complete blood picture and bleeding and coagulation profile.

Surgical technique

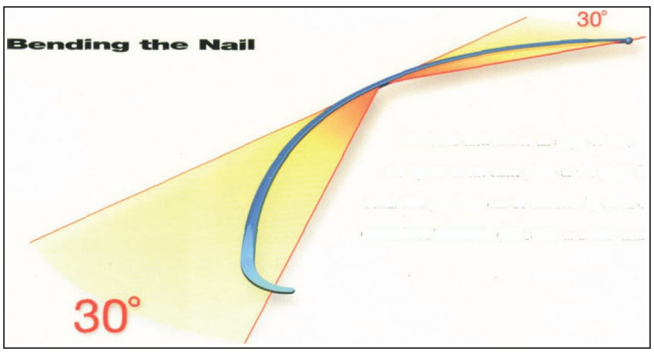
The size of the nail was determined by (0.4 x diameter of the medullary canal), the length of the nail is equal to the distance separating the proximal and distal growth plates, then prepending is done [4]

Always ensure that the length of the nail is such that it will protrude one or two centimeters outside the entry portal area (Fig. 1).

Figure 1

Length of the nail.

Figure 2



Pre-bending the nail.

Group A

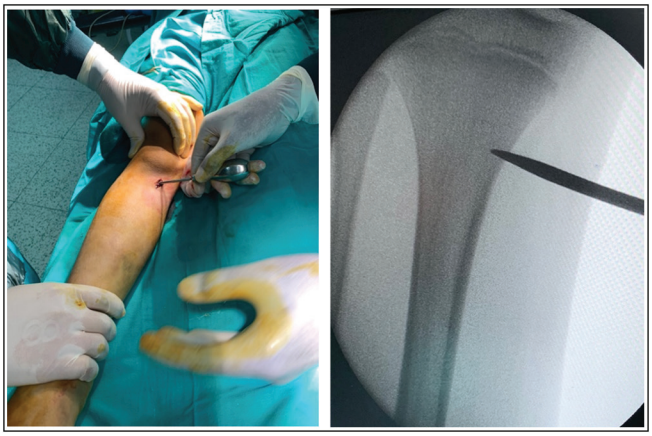
A single longitudinal incision about 2 cm long is made in the medial aspect of the leg, approximately 1–2 cm distal to the proximal tibial physis.

The first nail is C shape by bending the nail to an angle of 30° to 45 degrees with the apex of curvature lying at the level of the fracture site and the second nail is S shape by bending the nail to two angles of 30° to 45 degrees [4] (Fig. 2).

The entry hole is made with an awl into the medial cortex of the proximal metaphysis (Fig. 3).

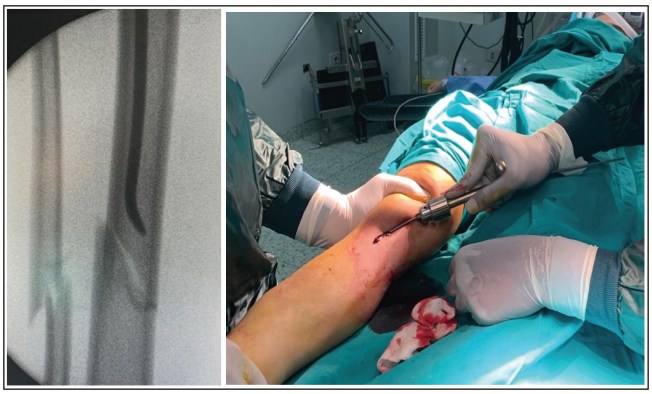
Pass the nail through the entry hole with the curved tip pointing downwards. Once in the medullary canal rotate the curved tip so that it is pointing in the

Figure 3



Nail entry.

Figure 4



Nail insertion.

Figure 5

Second nail entry.

direction in which the nail is to be passed. Drive the nail up the canal by rotating the T-Handle Inserter back and forth (Fig. 4).

Advance the second nail (S-shaped nail) through the same entry hole using the same T-Handle Inserter with back-and-forth movements. Do not rotate the second nail through a full 360‘ as this may result in the second nail wrapping itself around the first nail, Advance the nail to the fracture site then towards the metaphysis, and anchor it into the cancellous bone (Fig. 5).

Group B

Using two separate nail entries (medial-lateral sides) where the nails are bent to an angle of 30° to 45° to form the C shape, the same technique is used but with two separate incisions (medial and lateral)

Immediate postoperative back slab for the first 2 weeks for pain control. and at the beginning of the third week, partial weight-bearing is allowed. After the appearance of calcified external callus, full weight-bearing is allowed.

Follow-up was subjected to regular visits every 3 weeks for the Presence or absence of pain according to the FLACC behavioral Pain Assessment Scale, X-ray for union, presence of any deformity, and its degrees.

Results

30 patients with tibial shaft fractures were treated with EIMN From April 2020 to March 2021 and followed up for 6 months after surgery, the mean age was 8.43 ± 1.55.

Group A reported mild postoperative pain, with a significant difference (P value < 0.05) from group B

Figure 6

AP and lateral on admision.

Figure 7

One-month post-operative.

Figure 8

3 months post-operative.

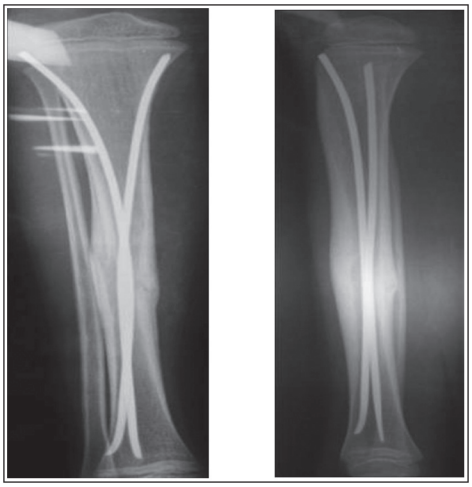
Figure 9

AP and lateral on admission.

Figure 10

AP and lateral 1 month postoperative.

Figure 11



AP and lateral 3 months postoperative.

who expressed moderate pain according to FLACC behavioral Pain Assessment Scale.

Group A has a significant (P value < 0.05) longer operative time (mean= 59.33 ± 8.84 min) than group B (mean = 41.67 ± 6.99 min), with a significant (P value < 0.05) shorter time for reaching full knee range in group A (mean = 3.6 ± 0.51 weeks). While there is no significant difference (P value > 0.05) between both techniques regarding time for reaching radiological union full bridge callus and painless full weight bearing.

One case showed a minor complication which was skin irritation at the entry site in group A which was relieved immediately after removal. There were no other complications detected in the rest of the cases.

Case presentation

Case 1

An 11-year-old, female patient presented with fractured right tibia treated with single entry ESIN (Figs. 6–8).

The assessment was done at 6 months postoperative; the patient was considered excellent according to Flynn scoring system. There was no LLD, no malalignment, no pain, or complications.

Case 2

An 8-year-old, male patient presented with fracture right tibia treated with double entry ESIN (Figs. 9–11).

The assessment was done at 6 months postoperative; the patient was considered excellent according to Flynn

scoring system. There was no LLD, no malalignment, no pain or complications.

Discussion

The elastic intramedullary nail is a better choice for tibial shaft fracture because there is a significant complication rate that accompanies fixation with plates and screws as well as with external fixation, such as infection, delayed union, refracture, malalignment, and joint stiffness [5].

When using the 2-incision approach, the lateral incision is generally made 2–3 cm proximal to the planned entry point; the entry point itself being at the level of the tibial tuberosity. The lateral incision poses a potential risk of injury to the peroneal nerve as it courses into the anterior compartment of the leg.

Due to these potential risks, a single-incision flexible intramedullary nail technique for pediatric tibial shaft fractures is available.

In this study, we evaluated the results of thirty patients who were treated From April 2020 to March 2021, with EIMN using a single medial incision with the use of one s-shaped nail and the other c shaped for 15 patients and double incision for 15 patients and followed up for of 6 months after surgery.

John *et al*. evaluate the result of 11 cases of pediatric tibial shaft fractures, 6 of which were treated with the single medial incision approach, the remaining 5 patients underwent the standard 2-incision approach [5].

The operative time was 43.34 min (30–50; the standard deviation of 7.5) for the single incision group and 45 min (25–55; the standard deviation of 10.5) for the dual incision group.

There was no statistical significance for operative time ($P = 0.40$). in contrast to this study where Single-entry technique has a significant (P value < 0.05) longer operative time (mean = 59.33 ± 8.84 min) than double-entry one (mean= 41.67 ± 6.99 min).

John *et al*. found that all patients had complete fracture healing at the 12-week follow-up, time to union was not found to be statistically significant between the two groups. There were no delayed union, nonunion, or malunion in either treatment group. None of the patients had a course complicated by infection or any other significant complications [5].

Similar results were found in this study where there is no significant difference (P-value > 0.05) between both techniques regarding time for reaching radiological union full-bridge callus and painless full weight-bearing.

A. Abdelbaset in 2018 [5] evaluated results of 20 children with tibial shaft fractures treated with flexible intramedullary nails. The age of the children ranged from 4 to 14 years old, the final follow-up period was 6 months from the date of the initial injury. They used a double incision. The mean period of full bridging callus formation was 9.05 weeks [6]. In this study, the mean period of full bridging callus formation was 8.53 in single-entry group which is the same in A. Abdelbaset study

In A. Abdelbaset's study, the mean period of full weight-bearing was 9.75 weeks while in this study the mean period of full weight-bearing was 7.53 weeks in the single-entry group [7].

Byanjankar *et al*. retrospectively reviewed 22 tibial shaft fractures in children treated operatively with titanium elastic nails. All patients achieved union at a mean of 10.3 weeks (8–14 weeks). Full weight-bearing was achieved at a mean of 9.2 weeks (8–14 weeks) [6].

At the last follow-up, the result was excellent in 18 patients and satisfactory in 4 patients. The most common complication was irritation at the nail entry site. Two cases had superficial wound infection at the entry site and both healed with oral antibiotics and dressing changes [6].

In this study the mean period of full bridging callus formation was 8.53 in the single entry group, which is the same in Byanjankar *et al*. study, the mean period of full weight-bearing was 7.53 weeks in single entry group which was better than Byanjankar *et al*. study.

Limitations of the study are the small patient population, and few studies are available, so further studies are necessary to further analyze the benefits of the single incision technique.

Conclusion

This technique has many advantages. as it is a minimally invasive surgery with a short duration of hospitalization. And single incision adds more privilege to be a minimally invasive surgery and the use of a single medial incision puts putting away any possibility of common peroneal nerve injury.

This study evaluates the advantage of the single medial incision flexible intramedullary nail technique in the treatment of unstable tibial shaft fractures. When the operative option is indicated, We consider this method of fixing pediatric tibial shaft fractures. However, future studies are required to further analyze the benefits as well as the long-term effects of the single-incision method.

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Conflicts of interest
No conflict of intrerest.

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