

# TENS FOR COMPLEX PEDIATRIC LONG BONE FRACTURES

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## ABSTRACT

**Objective:** Displaced fractures of the tibia, femur and forearm in the pediatric population can usually be reduced to an acceptable position by closed methods but the realization that malalignment leads to a less than normal or compromised functional result has led to a trend of intervention to avoid these complications. The lower morbidity associated with elastic intramedullary nails has been more acceptable to the orthopedic and trauma surgeons. This study assesses the results of the use of elastic nails for unacceptable position in pediatric long bone fractures.

**Study Design:** Descriptive, Case Series.

**Place and Duration of Study:** HBS Medical and Dental College, Islamabad and HITEC Institute of Medical Sciences, Taxila. January 2016 to March 2018.

**Material and Methods:** Twenty patients between the ages of 3-14 years were offered intervention by Titanium Elastic Nailing System (TENS) due to the unacceptable position of their fractures. The patients were then followed up three months after removal of their implant after union.

**Results:** There were 12 males and 8 females in this study. Thirty five percent of the patients were between the ages of 3 and 5 years while the rest (65%) were five to fourteen years of age. There was one case of loss of reduction and another in which there was superficial infection. Two patients complained of skin irritation from the implant.

**Conclusion:** Elastic nailing in complicated and malaligned long bone fractures in children is a reliable option for the orthopedic and trauma surgeon with very little morbidity and leads to satisfactory functional outcome, early union and permits easy implant removal.

**Keywords:** TENS, ESIN, Pediatric fractures, Femur shaft fractures, Tibia fractures, Forearm fractures, Maluniting

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## INTRODUCTION

Long bone fractures in the pediatric population are quite common<sup>1,2</sup>. In the earlier years the trauma is due to fall at home either by neglect or the child trying to discover the world. However, during school going years the increased activity level of the young children predisposes them to long bone fractures. A few decades ago treating them by close reduction and subsequently putting them in cast was the treatment of choice and any displacement and/or angulation occurring at the time of reduction or subsequently was accepted as it was believed that it would remodel. Secondary displacement and malalignment are common after close reduction and casting<sup>3</sup>. Over the years it became obvious that not all displacement or angulation corrects

as the child grows up and functional compromise is a rule in malunited fractures.

Surgical intervention by close reduction and internal fixation Close Reduction and Internal Fixation (CRIF) or Open Reduction and Internal Fixation (ORIF) by elastic nails has led to better healing times, lower morbidity and earlier return to pre-injury activity status<sup>4,5,6</sup>. Some common indications for surgery include failure of reduction, failure to maintain reduction in unstable fractures and open fractures<sup>7</sup>.

When comparing ORIF with plates and screws to intramedullary fixation it becomes obvious that ORIF is associated with larger scars, more tissue dissection, a higher incidence of infection and difficult implant removal. Intramedullary devices such as K wires and Rush pins are rigid, difficult to bend at metaphysis and difficult to manipulate. Elastic nails solve all these problems by being bent at the tip, being elastic and easy to manipulate and provide three point fixation within the canal. They are also easy to remove once union has occurred<sup>8</sup>. There is added advantage of preservation of the growth plate as these nails are inserted proximal or distal to the growth plates<sup>9</sup>.

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## MATERIAL AND METHODS

**Sampling Technique:** Non-probability, consecutive sampling.

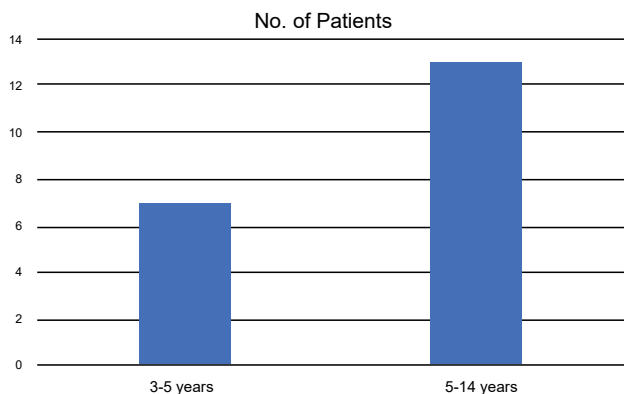
**Inclusion Criteria:**

Age: 3-14 years

Gender: Both males and females

Fractures: Diagnosed cases of displaced tibial shaft, femoral shaft, radius and ulna shaft fractures

**Exclusion Criteria:** Fractures at the end of the bones and intra articular fractures of long bones were excluded



**Graph 1: Age Distribution of Patients.**

**Table 1: Method of achieving reduction and fixation.**

ORIF	5
CRIF	15



**Figure 1: A maluniting fracture of the both bones of the forearm.**

**Table 2: Distribution of fractures according to bones involved.**

Tibia	7
Femur	8
Radius ulna	5



**Figure 2: The same fracture after close reduction and fixation with ESIN.**

## RESULTS

Out of 20 children in the study group 12 were males. A great majority of them belonged to the more physically active 5-14 years age group. There was only one case of loss of reduction after TENS subsequently while the other two complications were skin irritation and superficial infection in the same patient. There were no cases of deep infection, implant failure or difficulty in removing the implant after union had occurred. Open reduction was required in cases where either the callus had started to form or in early few cases of the forearm where control of radius by closed means was difficult as compared to ulna.

## DISCUSSION

Close reduction of long bone fractures has been the gold standard of treatment in children for ages. The cost was low and the results were generally acceptable. Union rates of more than 90% and full functional recovery have been reported by different authors<sup>10</sup>. At times, however, there is loss of reduction after manipulation or malrotation which warrants surgical intervention<sup>11</sup>.

TENS for long bone fractures was introduced in late 70s and has recently seen marked acceptance by the orthopedic and trauma

surgeons. The main reasons for this increased popularity is due to simple technique, low morbidity and excellent results. The original technique has seen few modifications since its inception which confirms its authenticity<sup>12</sup>. Entering the canal from the maximum diameter seems to be the ideal solution. Avoidance of the growth plate is also a crucial step. Bending the nails beyond their elastic limit to conform to the shape of the fractured bone with the maximum bow at the fracture site ensures stable fixation.

The results of TENS use in tibia fractures were compared with external fixator by Kubiak et al in 2005 and they reported 7 bony complications in the fixator group as compared to only one in the TENS group. Similarly, the union time was much shorter in the TENS group as compared to the external fixator group (7 weeks versus 18 weeks)<sup>13</sup>. The results have been varying regarding union but the overall impression is that there is earlier union after using the TENS. This is probably explained by keeping the fracture hematoma intact. Gordon JE and workers achieved union in 18 weeks while others reported union of tibia fractures occurring in 21.5 weeks<sup>14</sup>.

Sankar et al in their series of 19 children reported skin irritation at the nail entry site as their only complication. There were no cases of leg length discrepancy or diaphyseal arrest as the result of treatment by TENS<sup>15</sup>. In our study we saw that skin irritation was the most frequent complaint (2 patients) and was present in the earlier operated cases. As the experience with nail grew that complication was avoided. There was no case of leg length discrepancy in our series. O'Brien in his study reported union in 9 weeks with no case of leg length discrepancy or malunion<sup>16</sup>.

It was seen that none of the patients had refracture of the shaft of radius, ulna, femur or tibia once healing had occurred and the implant was removed within a year of performing the procedure. This is also confirmed by the study done by Liu P et al who reported that he had full range of motion with only two patients who had less than 1cm of shortening which was without any problem and there was no case of refracture<sup>17</sup>.

Excellent results were achieved in study performed by Ahmed EKF et al in 75% of patients while there were 25% good results. There were no cases of poor results<sup>18</sup>. Most series have reported very few complications associated with the use of flexible intramedullary nailing and have preferred this technique for fixation of pediatric forearm fractures<sup>19-25</sup>. Some latest research in closed fixation of tibia fractures in children even by locked plates is very promising as to lower complication rates and more acceptable alignment<sup>26</sup>.

We found gratifying results when the procedure was performed in the upper limb. There were no cases of neurovascular injury, little need to protect the limb after surgery of both bones of the forearm and earlier return to preinjury level of use of the involved limb. Smith and Fernandez in their studies comparing plating to intramedullary flexible nail found that there are advantages of cosmesis, easy removal of implants after union has occurred and little chance of neurovascular injury<sup>27,28</sup>.

Reduction and percutaneous fixation of both bone fractures of the forearm can be difficult at times due to the muscle mass and difficulty in reducing the radius. For that occasionally a mini incision has to be given to remove the intervening muscle and help passage of the elastic nails. This has been reported by Stanley and Wilkins et al. who had to reduce their first six fractures out of 50 through limited open approach<sup>29</sup>.

Removal of elastic nails is usually done after about six months. The removal is usually without difficulty and there is little evidence of refracture after removal in the literature. Slongo et al also did not have a single case of refracture after removal of elastic nails in their study<sup>30</sup>. In our study of twenty patients operated for different long bones fracture we did not have a single case of refracture after removal. This is definitely an advantage when compared with plating where protected weight bearing has to be considered after plate removal from the femur and/or the tibia.

Lee, Sang-Hee in his study have, however, highlighted the complication of leg length discrepancy which they found out was more related to age at which the injury took place<sup>31</sup>.

In another study by Kapil from Nepal, TENS was reported as safe, reliable and easy to perform procedure with low complication rate. The complications, they also noted, are easily avoidable and/or manageable<sup>32</sup>.

The most frequent problem encountered in different studies has been entry site skin irritation which the surgeons usually learn to avoid by cutting the ends deep into the tissues. This has been also observed by Ligier et al who had 13 cases of skin irritation or inflammation out of 123 cases (10.5%)<sup>33</sup>. We had two cases of skin irritation by prominent implant (10%) which goes well with the documented rate in other studies.

## AUTHORS' CONTRIBUTION

Kashif Khurshid Qureshi: Conception and design, Acquisition of data, Analysis and interpretation of data, Drafting and revision.

Iram Iqbal: Design, Analysis.

Khalid Z Aslam: Critical Revision.

Ahmed Jasra: Analysis and interpretation of data.

Sohail Akber: Analysis and interpretation of data.

Inam-ul-Haq: Drafting the article.

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