



COMPARISON OF CLINICAL OUTCOME OF TITANIUM ELASTIC NAIL AND PLATE OSTEOSYNTHESIS IN PAEDIATRIC FEMORAL DIAPHYSEAL FRACTURES

Orthopaedics

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ABSTRACT

Introduction- Femoral shaft fractures account for 1.6% of all pediatric fractures. In children aged 5 years or younger, early closed reduction and application of spica cast is an ideal treatment for most diaphyseal fractures. In skeletally mature adolescents, use of antegrade solid intramedullary rod has become the standard treatment. But, the best treatment for children between six to fourteen years of age is still under debate. Compared with younger children, patients in this intermediate age group have higher risk of shortening and malunion when conservative measures are used. **Material And Method-** This is a prospective and retrospective study in the patients admitted in Institute of Orthopaedics and Traumatology, J.L.N.M.C.H Bhagalpur. over a period of 24 months from November 2020 to September 2022 in whom fractures were treated by internal fixation either by standard dynamic compression plating or Titanium Elastic Nail System (TENS). Post operatively, the patients were followed up for clinical and radiological outcome of internal fixation either by Dynamic Compression Plating or Titanium elastic nailing. **Conclusion-** In our study, the TENS patients have minimal blood loss, the procedure is minimally invasive and has a good early union rate, short hospital stay & early return to school for the children. TENS has less infection rates when compared to Dynamic Compression Plating and is easy to remove.

KEYWORDS

INTRODUCTION-

In recent times, fixation with flexible intramedullary nails has become a popular technique, for stabilizing femoral fracture in school going children. TENS fixation system is a simple, effective and minimally invasive technique. It gives stable fixation with rapid healing and prompt return of child to normal activity. This study was intended to analyse the results following the treatment of fracture shaft of femur by flexible intra medullary nail (TENS) and dynamic compression plating.

Children managed with traction and spica cast as a treatment modality has to undergo various adverse physical, social, psychological and financial consequences of prolonged immobilization. Other modalities such as external fixation, plates with screws & use of flexible intramedullary nail are available. However, the risk of certain complications, such as pin tract infection, refractures after external fixation and osteonecrosis of the neck with solid nails are there.

MATERIAL AND METHODS- AIMS AND OBJECT

To compare the clinical and radiological outcome of paediatric femoral diaphyseal fractures treated with titanium elastic nail and plate fixation in cases admitted in Institute of Orthopaedics And Traumatology, J.L.N.M.C.H Bhagalpur over a period of 24 months from November 2020 to September 2022.

This is a prospective and retrospective study, which will provide data and the possible variations in the clinical and radiological outcome of titanium elastic nail and plate osteosynthesis in paediatric femoral diaphyseal fractures, complications and benefits of both procedures.

Inclusion Criteria

- Children and adolescent patient of age groups from 6 – 14 years with closed diaphyseal femur fracture.

Exclusion Criteria

- Age less than 6 and more than 14 years
- Compound fractures
- Pathological fractures.

Statics Analysis-

OBSERVATION AND RESULTS

All patients were followed until fracture union occurred. The follow up period ranged from 6 months to 24 months. Results were analysed both clinically and radiologically.

Age Incidence

	TENS	Plating
5-8 years	3	5

8-12 years	5	3
12-15 years	2	2

Most Of patients (40%) are between 5- 8 years

Time of clinical union was defined as the period between operation and full weight bearing without external support along with radiographically healed fracture (cortical continuity in all 4 cortices).

TENS – Complication

Limb lengthening	2(20%)
Infection	0
Delayed union / Non Union	nil
Nail Protrusion	nil
Mal alignment/ Varus angulation	2(20%)

Plate – Complication

Infection	2(20%)
Limb length discrepancy	1(10%)
Implant loosening	Nil
Non union	Nil
Mal Union	Nil

Range Of Motion Of Hip And Knee

One patient in TENS Group with bilateral femoral fracture had a stiffness of both knees which needed mobilization under anaesthesia. One patient in plating group with poly trauma had knee stiffness. Other patients had full range of motion of hip and knee, 1 patient had a local irritation which mandated TENS nail removal at 4th month.

Limb Length Discrepancy

Two patients had 2cm limb length discrepancy in TENS group. One patient belonging to the plating group also had limb length discrepancy of 2cm.

Infection

Deep infection was seen in 2 patients in Plating group and it was controlled by antibiotics and wound debridement.

Delayed Union And Non Union

No cases of delayed or non union were seen in our series.

Malalignment

- Two cases of varus malalignment (10° and 12°) were observed in TENS group. No cases of valgus, anteroposterior or rotational malalignment were observed.
- We analysed our final results with TENS Evaluation Score given by Flynn et al¹⁶.

Table: I: The Scoring Criteria for TENS

	Excellent	Successful	Poor
Limb length discrepancy	<1cm	<2cm	>2cm
Angulation/Mal alignment	5 °	10 °	>10 °
Pain	Absent	Absent	Present
Complication	Absent	Mild	Major complication or increased morbidity
	Results in DCP		Results in TENS
Excellent	8		8
Successful	0		1
Poor	2		1

Plating group has a mean radiological union of 9.9 ± 1.66 weeks. TENS group has a mean radiological union of 7.80 ± 1.03 weeks, which is statistically significant ($p < 0.01$). Plating group has a mean clinical union (full weight bearing) in 13 ± 2.05 weeks. Comparatively, the TENS group has a mean clinical union in 9.7 ± 1.4 weeks, which is statistically significant ($P < 0.01$)

RESULTS

In our study femoral shaft fractures were found to have high incidence in the age group of 9-10 years. Out of the 20 cases there were 12 (60%) males and 8 (40%) females. The most common mode of injury in our study was fall from height. In this study, 45% had femur shaft fracture in the middle 3rd. There were 80% transverse and 20% oblique fractures. The average amount of blood loss in plating was 150 ml and in TENS was 50 ml. Only one patient in plating group was immobilized with above knee slab.

Three patients in TENS group were immobilized with above knee slab. Plating group had a mean hospital stay of 18 days. The mean duration for toe touch walking was (started after the appearance of callus radiologically) 10 weeks and the mean duration for full weight bearing was 13.8 weeks in Plating group. In TENS group, the mean hospital stay was 11 days, the mean duration for toe touch walking was 7.42 weeks and the mean duration of full weight bearing was 9.28 weeks.

Table II Comparison of outcome variables between two groups: Significant Limb length inequality (≥ 2 cm) was found in one case (10%) in the plating group and two cases (20%) in TENS group at the end of 6 months. In all other cases in our study it was < 1 cm. Malalignment was not observed in the plating group and was noted in two cases (20%) of the TENS group. In the TENS group malalignment was in coronal plane and was $< 20^\circ$ in all the cases.

There were two (20%) cases in the Plating group with complications in the form of infection and none of the cases had implant failure. One (10%) patient in the TENS group developed complication in the form of entry point bursitis. Functional outcome was assessed by using Flynn's

TENS outcome score, applied to both the groups at the end of follow up. Functional outcome at the end of one year in the Plating group had poor results in three cases (30%) and excellent results in 7 cases (70%). TENS group had poor results in one case (10%), satisfactory results were observed in two cases (20%) and excellent results in 7 (70%) cases.

TABLE II

Complications	DCP	TENS	Total
Nil	7(70%)	7(70%)	14(70%)
Yes	3(30%)	1(10%)	4(20%)
Entry point bursitis	0	1(10%)	
Implant failure/knee stiffness	3(30%)	1(10%)	4(20%)

Case 1

Johnson 6 Year /Male Pre Op



1 year follow UP

DISCUSSION

As surgeons consider different methods to treat paediatric femur fractures and mobilize the injured child, the ideal mode of treatment remains controversial. Titanium elastic nails are popular for the management of length-stable femoral fractures in school going children. Though plating is a treatment option for femoral fractures for the ease of application and early mobilization, recently sub muscular plating has been found to be a successful alternative for the management of lengthunstable femoral fractures in school-going children.

In the present study, the average time taken for clinical union in patients treated with DCP was 13.87 ± 1.8 weeks and in patients treated with TENS was 9.28 ± 1.49 weeks which was statistically significant ($P < 0.01$).

In DCP group the radiological union time (10 ± 1.85 weeks) is slightly higher when compared to the results reported with the TENS group (7.42 ± 0.97 weeks). In our study, we advised the patients to start toe touch weight bearing with assistive devices as soon as the callus was visible radiologically. DCP group patients started toe touch walking at around 10 weeks, where as TENS group patients started toe touch walking earlier at 8 weeks. These results are similar to Fyodorov et al (6 weeks)⁴⁷ and Agus H (8.5 weeks)⁴⁸ in those treated with DCP for femur shaft fractures. And the study involving TENS as a treatment modality reports of about 4 weeks (Flynn JM et al). In TENS group only 3(30%) patients were immobilized with above knee slab. Eren OT⁴⁹ et al reported about 25% incidence of immobilization in patients treated with DCP and Flynn JM et al reported around 29.3% incidence of immobilization in femur shaft fractures treated with TENS. Similarly, Moroz LA et al⁵⁰ report it to be around 22.2% in the TENS Nail. As the decision to immobilize was based on fracture anatomy, the strength of the fixation and confidence of the operating surgeon, it is difficult to draw a statistically valid conclusion. Intra operative radiation exposure to surgeon is high in closed reduction and TENS group. Kraus et al⁵¹ (2008) performed retrospective analysis of 63 femoral and 24 tibial shaft fractures and found that the average radiation time in femoral fractures was 70.3 (range, 12- 193) seconds. Standard compression plating is an open procedure. It can be done without the use of intraoperative fluoroscopy.

In our study, after the procedure, all the patients except the ones who were immobilized were advised to move the hip and knee while lying on the bed from the second day. The presence of a large surgical wound and the associated pain in patients treated with DCP may have caused the delay in mobilization. Carey TP et al⁵² reported an average time of 5.5 days for mobilization with TENS. Similarly Flynn JM et al reported it as 9 days. Timothy W et al⁵³ reported an average time for mobilization as six weeks in patients treated with DCP.

Compared to those treated with DCP may probably be because of the extensive surgical exposure in DCP group and wound dressings. It was more commonly influenced by the financial constraints of the patient.

In our study we noted that the limb length discrepancy (LLD) was around 1 case (10%) in the DCP group and around 2 cases (20%) in the TENS group. There is a wide range of limb length inequality reported in other studies. Timothy W et al reports 4.3% whereas, Eren OT et al reported around 5.4% in femur shaft fractures treated with DCP. In patients treated with TENS, reports by Ligier JN et al, Saikia KC et al

and Roop Singh et al⁵⁴ have recorded 12%, 13.6% and 8.5% of LLD respectively. Malalignment (angulation or rotation) was not found in the DCP group and was 20% (2) in the TENS Group (varus angulation only, no rotation). None of the cases showed $>20^\circ$ of malalignment. Carey TP et al, Ligier JN et al, Saikia KC et al and Roop Singh et al reported 8%, 11%, 9.09% and 8.57% incidence of malalignment in cases treated with TENS respectively. In our study, 2 cases out of 8 in DCP group developed complications in the form of infection and wound debridement was done and one case (10%) developed knee stiffness. The patients (2) who had infection were dealt individually. In TENS group one patient (10%) developed knee stiffness. Two patient (20%) developed nail irritation and pain which mandated the removal at the 4th month post operatively.

Functional outcome was assessed in both DCP and TENS group by applying the Flynn's outcome scoring system (2004) at the end of one year. DCP group had poor results in 3 cases (30%) and excellent results in 7 cases (70%). In the TENS group, Poor results in one case (10%), satisfactory results were observed in 2 cases (20%) and excellent results in 7 cases (70%).

CONCLUSION

In our study, the TENS patients have minimal blood loss, the procedure is minimally invasive and has a good early union rate, short hospital stay & early return to school for the children. TENS has less infection rates when compared to Dynamic Compression Plating and is easy to remove.

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