

## ORIGINAL ARTICLE

### COMPARATIVE STUDY BETWEEN TITANIUM ELASTIC NAILING (TENS) AND DYNAMIC COMPRESSION PLATING (DCP) IN THE TREATMENT OF FEMORAL DIAPHYSEAL FRACTURES IN CHILDREN

Ramasubba Reddy M<sup>1</sup>, Srinivasa Reddy Datla<sup>2</sup>, Priyank Uniyal<sup>3</sup>, Rakesh Reddy<sup>4</sup>

#### HOW TO CITE THIS ARTICLE:

Ramasubba Reddy M, Srinivasa Reddy Datla, Priyank Uniyal, Rakesh Reddy. "Comparative Study between Titanium Elastic Nailing (Tens) and Dynamic Compression Plating (DCP) in the Treatment of Femoral Diaphyseal Fractures in Children". Journal of Evidence based Medicine and Healthcare; Volume 2, Issue 32, August 10, 2015; Page: 4822-4835, DOI: 10.18410/jebmh/2015/674

**ABSTRACT: BACKGROUND:** Orthopaedic surgeons have long maintained that all children who have sustained a diaphyseal fracture of femur recover with conservative treatment, given the excellent remodeling ability of immature bone in children. Angulations, shortenings and malrotations are not always corrected by conservative treatment. Of many surgical options, titanium elastic nailing has been the newer implant which is being used regularly. Although good results have been reported with elastic intramedullary nails, plate fixation continues to be a viable alternative in surgical treatment of femoral shaft fractures. However there are not many studies comparing the efficiency of titanium elastic nailing and plating for femoral diaphyseal fractures in pediatric age group. **AIM:** The present study aims to compare the surgical management of diaphyseal fractures of femur in children with Dynamic Compression Plating versus Titanium Elastic Nailing. **DESIGN:** This is a prospective study. **MATERIALS AND METHODS:** This prospective study was conducted in a tertiary hospital. Patients who presented to the out-patient department and casualty of the hospital with femoral diaphyseal fractures during April 2012 to June 2014 were considered for the study. Subjects fulfilling the predetermined inclusion and exclusion criteria were included in the study. **STATISTICAL METHODS:** Fisher Exact test, Chi-Square Test, Student t test (Two tailed, independent). **RESULTS:** Patients in the age group of 6-14 years were considered for the study, Patients were divided into two groups and treated with DCP/TENS. The duration of surgery, hospital stay, and, amount of blood loss was minimal in TENS group. Callus was seen early in TENS group. Radiological union was early in TENS group by 2-3 weeks. Outcome was better in patients treated with TENS (Excellent-70%; Satisfactory-30%; Poor-0%) in comparison to DCP (Excellent-70%; Satisfactory-25%; Poor-5%). **CONCLUSION:** TENS is more versatile and can achieve biological fixation, with minimal complications compared to DCP hence it is concluded that TENS is better procedure for fracture shaft femur in children than DCP.

**KEYWORDS:** Femur, Diaphysis, Fracture, Children, Tens, Dcp, Biological fixation.

**INTRODUCTION:** Femoral shaft fracture is an incapacitating pediatric injury.<sup>1</sup> Femoral shaft fractures, including subtrochanteric and supracondylar fractures, represent approximately 1.6% of all body injuries in children.<sup>2</sup> The annual rate of femur shaft fractures in children was 1 per 5000.<sup>2</sup> However, incidence appears to show minor variations in its geographical distribution.

Orthopaedic surgeons have long maintained that all children who have sustained a diaphyseal fracture of femur recover with conservative treatment, given the excellent remodeling

## ORIGINAL ARTICLE

---

ability of immature bone in children. But time and experience of many surgeons have shown that diaphyseal femur fractures in children do not always recover completely with conservative treatment.<sup>3</sup> Angulations, shortenings and malrotations are not always corrected by conservative treatment.<sup>4</sup>

Over the past two decades, pediatric orthopedists have increasingly recognized the advantages of fixation and rapid mobilization. An ideal fixation device for pediatric femur fractures would act as a load sharing "internal splint", maintaining reduction for few weeks until callus forms. Most importantly, implantation should endanger neither the physis nor the blood supply of femoral head.<sup>5</sup> there are a wide variety of non-surgical treatment and surgical options available such as spica casting, traction followed by casting, plate fixation, reamed intramedullary rods and flexible intramedullary nails with no clear consensus as to the preferred treatment.<sup>6</sup>

Of many options, titanium elastic nailing has been the newer implant which is being used regularly. Titanium implants are increasingly being used for elastic intramedullary nailing. The material properties of titanium confer advantages for an implant used to stabilize pediatric femur fractures.<sup>3</sup>

Although good results have been reported with elastic intramedullary nails, plate fixation continues to be a viable alternative in surgical treatment of femoral shaft fractures.<sup>7</sup> It is also considered that, compression plate fixation is a safe and effective treatment in children with both isolated femoral shaft fracture and those associated multiple injuries.<sup>8</sup>

However there are not many studies comparing the efficiency of titanium elastic nailing and plating for femoral diaphyseal fractures in pediatric age group. As a result of these management dilemmas we conducted this comparative study on the use of titanium elastic nailing and dynamic compression plating for the treatment of children with diaphyseal femur fractures.

### **MATERIALS AND METHODOLOGY:**

#### **Data Source:**

This prospective study was conducted in a tertiary hospital, Patients who presented to the out-patient department and casualty of the hospital with femoral diaphyseal fractures during April 2012 to June 2014 were considered for the study. Subjects fulfilling the predetermined inclusion and exclusion criteria were included in the study. Ethical approval for this study was obtained from ethics review board of this hospital.

**Method of Collection of Data:** The collection of data was done through a Performa from the cases included in the study by predetermined fixed inclusion and exclusion criteria's.

#### **Inclusion Criteria:**

- Age- 6-14 years.
- Sex- Males and females.
- Closed femur diaphyseal fractures.
- Patients who are available for follow up.
- Parents/guardians of the patients who gave consent for the study and the proposed procedure.

**Exclusion Criteria:**

- Age- <6 years & >14 years.
- Open fractures.
- Neurovascular compromise.
- Diaphyseal fractures with metaphyseal extensions.
- Neuromuscular disorders.
- Pathological fractures.

The selected 40 patients were not the consecutive patients (Because patients who presented with characters mentioned in exclusion criteria are excluded from study), among that each two identical geometric fracture pattern cases were selected and placed one in each group (TENS and DCP) for management.

**Preoperative Evaluation and Treatment:**

- **Method of treatment**

40 geometrically identical femoral diaphyseal fractured patients were selected and divided into two groups and they were treated with Dynamic Compression Plate (DCP) or Titanium Elastic Nailing (TENS) depending on the group the subject belonged. Implants used in all cases were from Indian manufacturers.

**Procedure.<sup>2</sup> - Preoperative Preparation:**

- Anaesthesia: General anaesthesia.
- Position of the patient:

**DCP:** Supine position with sand bag under the buttock and pillow under thigh on the affected side.

**TENS:** Hip and knee on the affected side extended on the fracture table and opposite limb in flexion abduction and external rotation of the hip with flexion of knee.

Preoperative scrubbing with betadine scrub and Savlon. Part painted with spirit and betadine. Parts were prepared in the operation theatre. Hairs were removed with hair clipper.

**Technique for ORIF with DCP fixation.<sup>2,7,8</sup>**

1. Postero- Lateral approach for femur.
2. Incision of 10-15 cms was made on the posteriolateral aspect of the thigh, in line with the lateral epicondyle of femur.
3. After incising the deep fascia in line with the incision, the vastus lateralis is reflected anteriorly, dissecting between the muscle and the lateral intermuscular septum to reach the linea aspera.
4. Muscles covering the femur are stripped by subperiosteal dissection.
5. Analysis of the fracture geometry done.
6. After achieving the temporary anatomical stable reduction with k-wires, it was fixed with Dynamic Compression Plate.

## ORIGINAL ARTICLE

Care was taken to either ligate or coagulate the perforating branches of the profunda femoris. The wound was given a thorough wash and wound was sutured in layers over a suction drain after achieving haemostasis.

### Technique for CRIF with TENS<sup>2,3,4,5,9</sup>

1. The insertion points on femur are 1-2cms proximal to the distal epiphyseal plate, determined under image intensifier.
2. A skin incision is placed at the planned nail insertion points and extended distally for 2-3 cms.
3. Medullary cavity is opened with a bone awl symmetrical on either sides of the femur shaft.
4. Nails of predetermined diameter are prebend and inserted to the medullary cavity with the help of a nail inserter.
5. The tips of the nail should just touch the tip of the metaphysis.
6. Care is taken such that both the nails cross the fracture site simultaneously and there is no rotational malalignment after nail insertion.

### Postoperative Management.<sup>2,4,5,9</sup>

1. Postoperatively 2 days of intravenous third generation cephalosporin and oral antibiotics for 3 days was used.
2. Splinting in the form of hip spica was used depending on fracture geometry and stability of fixation.
3. Isometric quadriceps strengthening exercise, hip and knee joint mobilization exercises were advised on first post-operative day, depending on fracture geometry, stability of fixation and pain tolerance of the patient.
4. Toe touch walking was delayed till the appearance of callus radiologically.
5. Stitches were removed on 12<sup>th</sup>-14<sup>th</sup> postoperative day.
6. All the patients had regular follow ups with no drop outs. During each visit they were subjectively, objectively and radiologically assessed.
7. Each patient in the study had a follow up of at least one year.

### EVALUATION OF POST OPERATIVE RESULTS WITH TENS OUTCOME SCORE.<sup>5</sup> BY FLYNN ET AL

The TENS outcome score suggested by Flynn et al.<sup>5</sup> was applied to all the cases in the study at fracture union, irrespective of the mode of treatment and outcome was grouped as Excellent / Satisfactory / Poor.

| Parameter              | Excellent | Satisfactory       | Poor                              |
|------------------------|-----------|--------------------|-----------------------------------|
| Limb Length inequality | <1cms     | >2cms              | >2cms                             |
| Malalignment           | 5 Degrees | 10 Degrees         | >10 Degrees                       |
| Pain                   | None      | None               | Present                           |
| Complications          | None      | Minor and resolved | Major with long lasting morbidity |

TABLE: 1 TENS OUTCOME SCORE.<sup>5</sup>

## Statistical Methods.<sup>10,11, 12,13</sup>

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean  $\pm$  SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups Inter group analysis) on metric parameters, Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

1. Fisher Exact test
2. Chi-Square Test
3. Student t test (Two tailed, independent)

+ Suggestive significance (P value:  $0.05 < P < 0.10$ )

\* Moderately significant (P value:  $0.01 < P \leq 0.05$ )

\*\* Strongly significant (P value:  $P \leq 0.01$ )

**Statistical Software:** The Statistical softwares SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel for graphs and charts.

## OBSERVATION AND RESULTS:

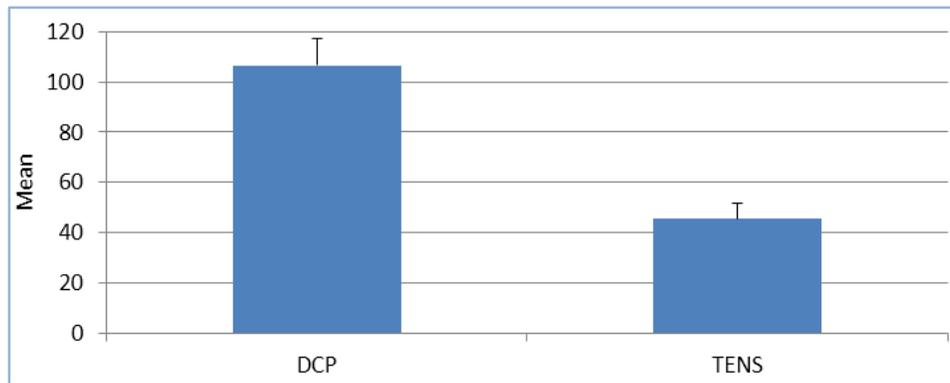
**Study Design:** Present study is a comparative evaluation of two surgical procedures. 40 patients were selected for this study based on identical geometric fracture pattern, and were divided into two groups of 20 each, and Group I treated with DCP and Group II treated with TENS. Results were compared in terms of fracture union time (clinically and radiographically) immediate, late and delayed post-operative complications, functional outcome with respect to range of movement achieved after fracture union. Advantages and disadvantages of the two procedures were evaluated.

|                            | Surgery Done |       |               |      | t     | df | p value  |
|----------------------------|--------------|-------|---------------|------|-------|----|----------|
|                            | DCP (n = 20) |       | TENS (n = 20) |      |       |    |          |
|                            | Mean         | S D   | Mean          | S D  |       |    |          |
| BLOOD LOSS IN ML           | 106.5        | 10.89 | 45.3          | 6.58 | 21.52 | 38 | p <0.001 |
| DURATION OF SURGERY IN MIN | 102.5        | 11.18 | 83.0          | 5.94 | 6.89  | 38 | p <0.001 |

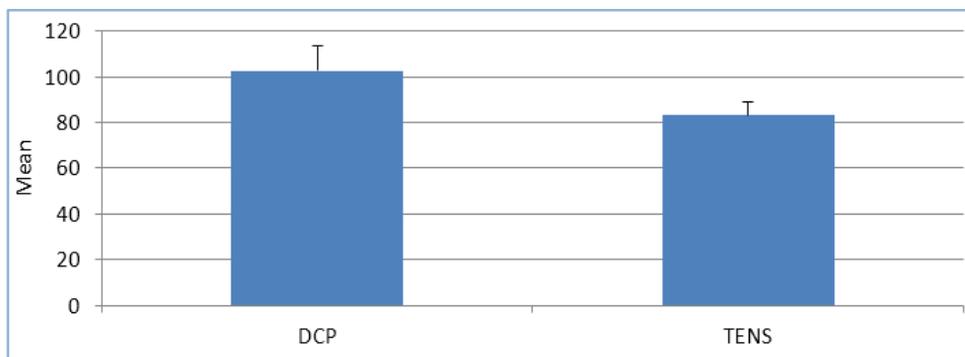
**Table 2: Comparison of Duration of surgery (Mins) and Blood loss (ml) between two groups**

All the TENS group underwent closed reduction only and there was no need for open reduction in our study.

# ORIGINAL ARTICLE



**Graph 1: Comparison of blood loss of each procedure**



**Graph 2: Comparison of duration of each Procedure**

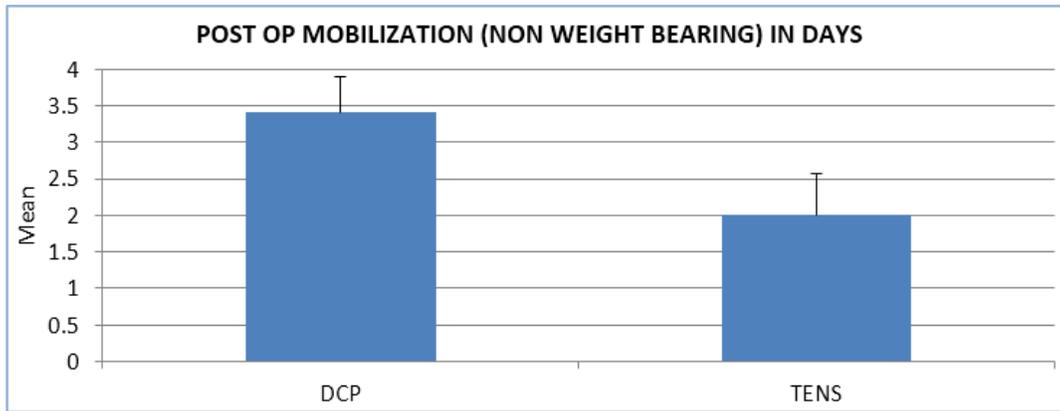
| POST OP MOBILIZATION<br>(NON WEIGHT BEARING)IN<br>DAYS | Surgery Done |               |           |               | Total     |              |
|--|--------------|---------------|-----------|---------------|-----------|--------------|
|  | DCP          |               | TENS      |               |           |              |
|  | Count        | %             | Count     | %             | Count     | %            |
| 1  | 0            | 0.0           | 2         | 10.0          | 2         | 5.0          |
| 2  | 0            | 0.0           | 17        | 85.0          | 17        | 42.5         |
| 3  | 12           | 60.0          | 0         | 0.0           | 12        | 30.0         |
| 4  | 8            | 40.0          | 1         | 5.0           | 9         | 22.5         |
| <b>Total</b>   | <b>20</b>    | <b>100.0%</b> | <b>20</b> | <b>100.0%</b> | <b>40</b> | <b>100.0</b> |

**Table 3: Comparison of post op mobilization (non-weight bearing) between two procedures**

|   | Surgery Done |      |               |      | t    | df | p value             |
|---|--------------|------|---------------|------|------|----|---------------------|
|   | DCP (n = 20) |      | TENS (n = 20) |      |      |    |                     |
|   | Mean         | S D  | Mean          | S D  |      |    |                     |
| POST OP MOBILIZATION (NON-<br>WEIGHT BEARING) IN DAYS | 3.4          | 0.50 | 2.0           | 0.56 | 8.30 | 38 | <b>p &lt; 0.001</b> |

**Table 4**

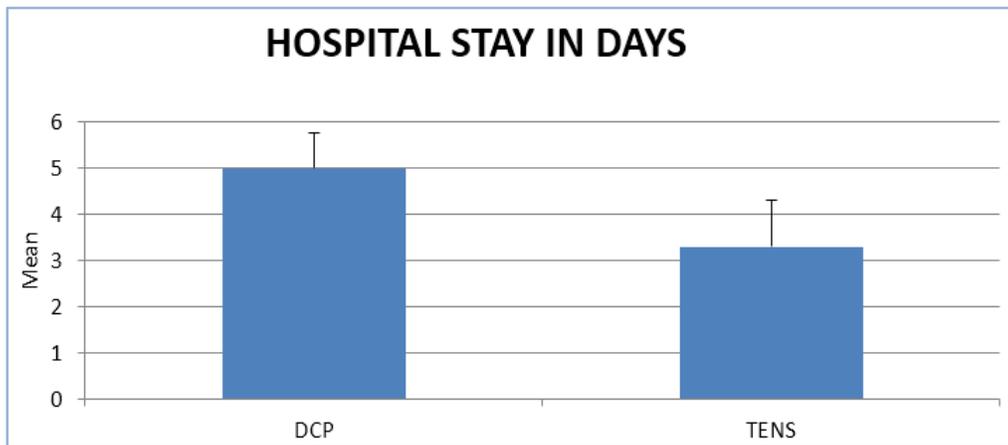
# ORIGINAL ARTICLE



**Graph 3: post op mobilization (non-weight bearing) in days between the two procedures**

|                       | Surgery Done |      |               |      | t    | df | p value            |
|-----------------------|--------------|------|---------------|------|------|----|--------------------|
|                       | DCP (n = 20) |      | TENS (n = 20) |      |      |    |                    |
|                       | Mean         | S D  | Mean          | S D  |      |    |                    |
| HOSPITAL STAY IN DAYS | 5.0          | 0.76 | 3.3           | 1.02 | 5.98 | 38 | <b>p &lt;0.001</b> |

**Table 5: Comparison of days spent in the hospital between the two groups**

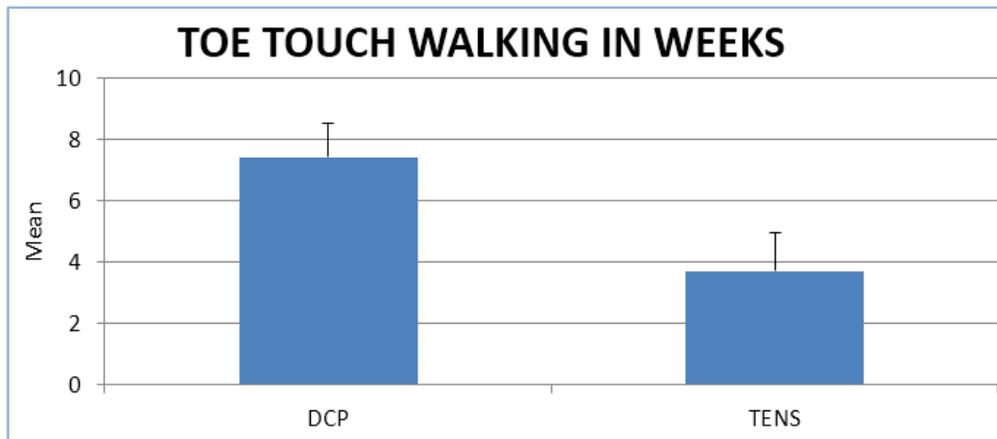


**Graph 4: Comparison of days spent in the hospital between the two groups**

|                            | Surgery Done |      |               |      | t     | df | p value            |
|----------------------------|--------------|------|---------------|------|-------|----|--------------------|
|                            | DCP (n = 20) |      | TENS (n = 20) |      |       |    |                    |
|                            | Mean         | S D  | Mean          | S D  |       |    |                    |
| TOE TOUCH WALKING IN WEEKS | 7.4          | 1.10 | 3.7           | 1.27 | 10.01 | 38 | <b>p &lt;0.001</b> |

**Table 6: Comparison of time taken for toe touch walking between the two procedures**

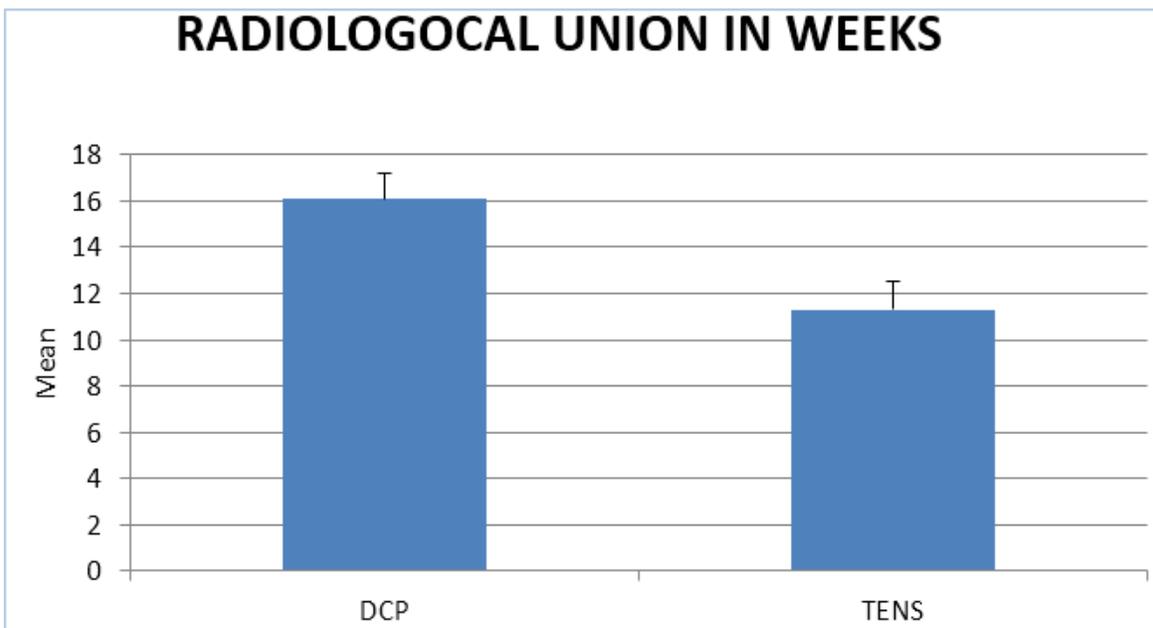
# ORIGINAL ARTICLE



**Graph 5: Comparison of time taken for toe touch walking between the two procedures**

|                             | Surgery Done |      |               |      | t     | df | p value  |
|-----------------------------|--------------|------|---------------|------|-------|----|----------|
|                             | DCP (n = 20) |      | TENS (n = 20) |      |       |    |          |
|                             | Mean         | S D  | Mean          | S D  |       |    |          |
| RADIOLOGICAL UNION IN WEEKS | 16.1         | 1.12 | 11.3          | 1.22 | 12.98 | 38 | p <0.001 |

**Table 7: Comparison of time taken for union in the two procedures**



**Graph 6: Comparison of time taken for union in the two procedures**

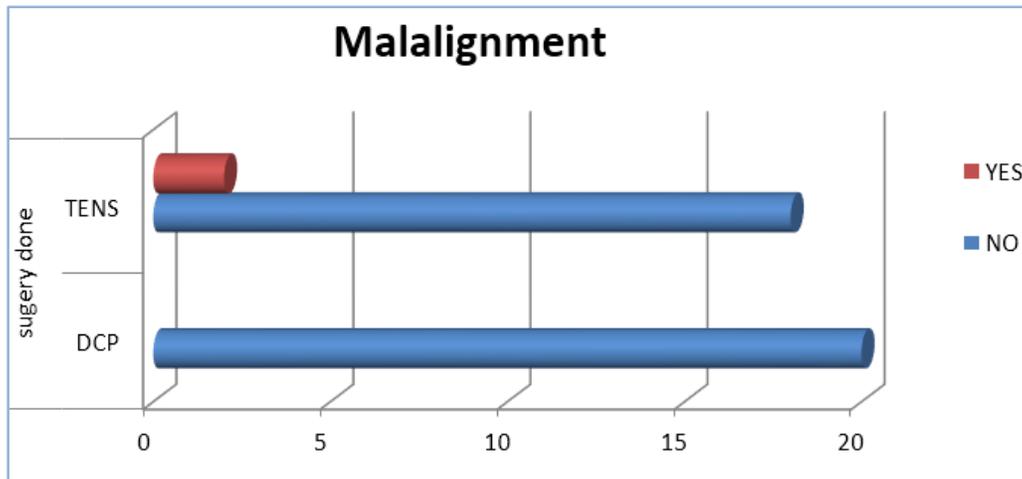
## ORIGINAL ARTICLE

| LIMB LENGTH<br>INEQUALITY | surgery done |              |           |              | Total     |               |
|---------------------------|--------------|--------------|-----------|--------------|-----------|---------------|
|                           | DCP          |              | TENS      |              |           |               |
|                           | Count        | %            | Count     | %            | Count     | %             |
| LENGTHENING 1CM           | 1            | 5.0          | 0         | 0.0          | 1         | 2.5           |
| LENGTHENING 2CM           | 2            | 10.0         | 1         | 5.0          | 3         | 7.5           |
| NO                        | 17           | 85.0         | 18        | 90.0         | 35        | 87.5          |
| SHORTENING 1 CM           | 0            | 0.0          | 1         | 5.0          | 1         | 2.5           |
| <b>Total</b>              | <b>20</b>    | <b>100.0</b> | <b>20</b> | <b>100.0</b> | <b>40</b> | <b>100.0%</b> |

Table 8: Comparison of limb length inequality between the two procedures

| MALALIGNMENT | Surgery done |              |           |              | Total     |              |
|--------------|--------------|--------------|-----------|--------------|-----------|--------------|
|              | DCP          |              | TENS      |              |           |              |
|              | Count        | %            | Count     | %            | Count     | %            |
| NO           | 20           | 100.0        | 18        | 90.0         | 38        | 95.0         |
| YES          | 0            | 0.0          | 2         | 10.0         | 2         | 5.0          |
| <b>Total</b> | <b>20</b>    | <b>100.0</b> | <b>20</b> | <b>100.0</b> | <b>40</b> | <b>100.0</b> |

Table 9: Comparison of malalignment between the two procedures



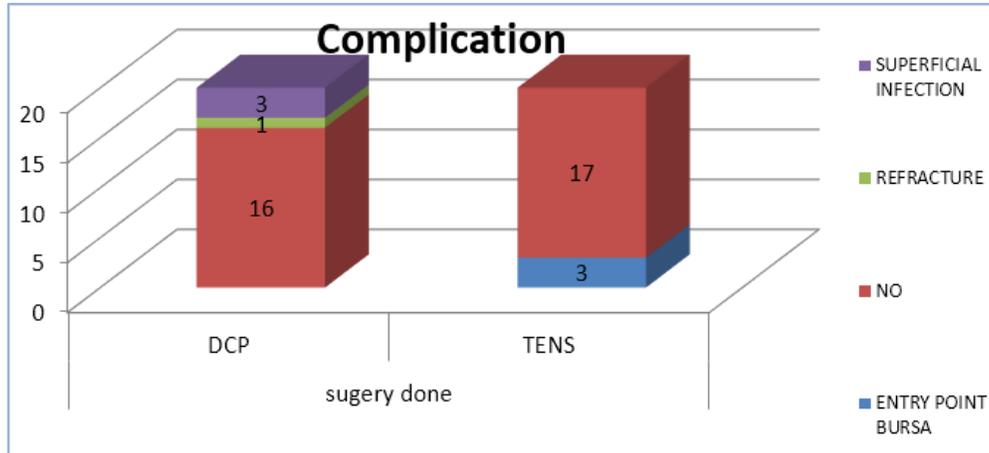
Graph 7: Comparison of malalignment between the two procedures

| COMPLICATIONS     | surgery done |      |       |      | Total |      |
|-------------------|--------------|------|-------|------|-------|------|
|                   | DCP          |      | TENS  |      |       |      |
|                   | Count        | %    | Count | %    | Count | %    |
| ENTRY POINT BURSA | 0            | 0.0  | 3     | 15.0 | 3     | 7.5  |
| NO                | 16           | 80.0 | 17    | 85.0 | 33    | 82.5 |
| REFRACTURE        | 1            | 5.0  | 0     | 0.0  | 1     | 2.5  |

# ORIGINAL ARTICLE

|                       |           |              |           |              |           |              |
|-----------------------|-----------|--------------|-----------|--------------|-----------|--------------|
| SUPERFICIAL INFECTION | 3         | 15.0         | 0         | 0.0          | 3         | 7.5          |
| <b>Total</b>          | <b>20</b> | <b>100.0</b> | <b>20</b> | <b>100.0</b> | <b>40</b> | <b>100.0</b> |

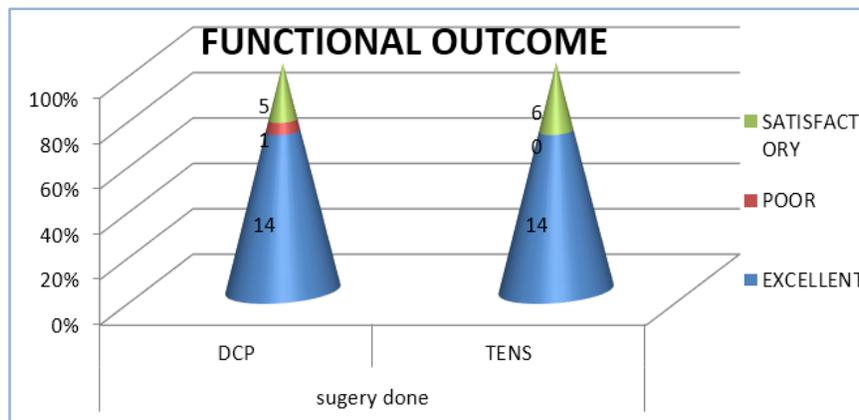
Table 10: Comparison of complications between the two procedures



Graph 8: Comparison of complications between the two procedures

| FUNCTIONAL OUTCOME | surgery done |              |           |              | Total     |              |
|--------------------|--------------|--------------|-----------|--------------|-----------|--------------|
|                    | DCP          |              | TENS      |              | Count     | %            |
|                    | Count        | %            | Count     | %            |           |              |
| EXCELLENT          | 14           | 70.0         | 14        | 70.0         | 28        | 70.0         |
| POOR               | 1            | 5.0          | 0         | 0.0          | 1         | 2.5          |
| SATISFACTORY       | 5            | 25.0         | 6         | 30.0         | 11        | 27.5         |
| <b>Total</b>       | <b>20</b>    | <b>100.0</b> | <b>20</b> | <b>100.0</b> | <b>40</b> | <b>100.0</b> |

Table 11: Comparison of functional outcome between the two procedures



Graph 9: Comparison of functional outcome between the two procedures

## ORIGINAL ARTICLE

**DISCUSSION:** Pediatric femur fractures command a great deal of attention for several reasons. These injuries can be treated with a wide variety of methods, and although most children do well regardless of treatment method, complications are not uncommon and sometimes debilitating. For generations, our orthopedic ancestors treated pediatric femur fractures with casting or traction followed by casting. In the last 3 decades, however, there has been a very strong trend for pediatric orthopedic traumatologists to use some form of fixation to mobilize the child. As surgeons consider different methods to treat pediatric femur fractures and mobilize the injured child, the ideal mode of treatment remains controversial.

The study included totally 40 cases in the age group of 6-14 years with identical femur shaft fractures which were divided into two groups, with 20 cases in each group (Group - I: DCP & Group-II TENS). Each patient included in the study was followed up for a minimum of one year and the analysis of the results were made with respect to age of the subjects, sex distribution in the study population, the mode of injury, laterality of fracture, the level of fracture, the type of fracture, associated injuries, mean duration of surgery, average amount of blood loss, mode and time of mobilization, time taken for union and functional outcome after the treatment

| Study                          | Procedure           | Duration of Surgery (mins)     |
|--------------------------------|---------------------|--------------------------------|
| Sink EL et al. <sup>14</sup>   | DCP                 | 107                            |
| Saikia KC et al. <sup>15</sup> | TENS                | 70                             |
| Lubica JC et al                | DCP<br>TENS         | 75<br>73.3                     |
| <b>Our study</b>               | <b>DCP<br/>TENS</b> | <b>102.5±11.18<br/>83±5.94</b> |

**Table 12: Comparison of duration of surgery**

| Study                           | Duration of stay(days) |
|---------------------------------|------------------------|
| Timothy W et al. <sup>16</sup>  | 13                     |
| Agus H et al. <sup>17</sup>     | 14±5                   |
| Fyodorov I et al. <sup>18</sup> | 7.7                    |
| <b>Our study</b>                | <b>5±0.76</b>          |

**Table 13: Comparison of duration of hospital stay in Group-I (DCP)**

| Study                          | Duration of stay(days) |
|--------------------------------|------------------------|
| Roop Singh et al. <sup>3</sup> | 12.3                   |
| Ligier JN et al. <sup>9</sup>  | 4.5                    |
| Saikia KC et al. <sup>15</sup> | 9.2                    |
| <b>Our study</b>               | <b>3.3±1.02</b>        |

**Table 14: Comparison of duration of hospital stay in Group-II (TENS)**

In our study we advised the patients pain tolerated toe touch weight bearing with assistive devices as soon as the callus was visible radiologically.

## ORIGINAL ARTICLE

Group-I patients started toe touch walking at around  $7.4 \pm 1.10$  weeks whereas Group-II patients started toe touch walking early at  $3.7 \pm 1.27$  weeks which statistically significant with p value  $< 0.001$ . The results are similar to Fyodorov I et al.<sup>18</sup> 6 weeks and Agus H.<sup>17</sup> 8.5 weeks in those treated with DCP for femur shaft fractures. And the study involving TENS as treatment modality report of about 4 weeks (Flynn JM et al.<sup>5</sup>).

The average time taken for union in Group-I was  $16.1 \pm 1.12$  weeks and that for Group-II was  $11.3 \pm 1.22$  weeks which was statistically significant. In Group-I the union time is slightly higher when compared to reported results.<sup>8,18,17,14</sup> and in Group-II it is comparable to reported time for union.<sup>3, 5, 19, 15</sup>

In our study we noted the limb length inequality was around 15% (3) in Group-I and around 10% (2) in Group-II but the distribution was statistically similar in both the groups. In both groups all cases of limb length inequality were  $\leq 2$ cms. There is wide range of limb length inequality reported in other studies. Timothy W et al.<sup>16</sup> reports 4.3% whereas Eren OT et al.<sup>7</sup> report around 54% in femur shaft fractures treated with DCP. In patients treated with TENS reports, by Ligier JN et al,<sup>9</sup> Saikia KC et al.<sup>15</sup> and Roop Singh et al.<sup>3</sup> reports 12%, 13.6% and 8.5% respectively.

Malalignment (angulation or rotation) was not found in Group-I and was 10% (2) in Group-II (angulation only, no rotation), which was statistically similar in both the groups, none of the cases showed  $> 5^\circ$  of malalignment. Carey TP et al,<sup>19</sup> Ligier JN et al,<sup>9</sup> Saikia KC et al.<sup>15</sup> and Roop Singh et al.<sup>3</sup> report 8%, 11%, 9.09% and 8.57% incidence of malalignment in cases treated with TENS respectively.

In our study 4 cases in group-I out of 20 cases developed complications in the form superficial infection in 3 and refracture in 1. The cases which developed superficial infection was resolved with regular dressings and extended oral antibiotics. The patient who had refractured at end of 10 weeks was due to fall from his bed in his house. Implant was removed followed by refixation with longer DCP.

Fracture united, with only 0-80° of knee flexion He was advised physiotherapy at the last follow up. Group-II had 3 cases with minor complications. Three cases (15%) had bursae at the site of entry point in distal femur, which could have been avoided by leaving shorter length of nail outside femur and proper trimming of the nail ends.

Functional outcome was assessed in both Group-I and Group-II by applying the TENS outcome scoring.<sup>9</sup> system, which was statistically similar in both the groups.

|              | <b>Our study</b>              | <b>Roop Singh et al.<sup>3</sup></b> | <b>Flynn JM et al.<sup>5</sup></b> | <b>Moroz LA et al.<sup>20</sup></b> | <b>Saikia KC et al.<sup>15</sup></b> |
|--------------|-------------------------------|--------------------------------------|------------------------------------|-------------------------------------|--------------------------------------|
| Excellent    | Group-I: 70%<br>Group-II: 70% | 71.4%                                | 67.3%                              | 65%                                 | 59%                                  |
| Satisfactory | Group-I: 25%<br>Group-II: 30% | 22.8%                                | 31%                                | 25%                                 | 27.2%                                |
| Poor         | Group-I: 5%<br>Group-II: 0    | 5.8%                                 | 1.7%                               | 10%                                 | 13.6%                                |

**Table 15: Comparison of functional outcome**

**BIBLIOGRAPHY:**

1. Flynn JM, Skaggs DL, Sponseller PD et.al. The operative management of pediatric fractures of the lower extremity. *J Bone Joint Surg (Am)* 2002; 84:2288-2300.
2. Rockwood & Wilkin's Fractures in Children. Femoral shaft fractures. 6<sup>th</sup> Ed. 893-936.
3. Roop Singh, SC Sharma, Magu NK, Amit Singla. Titanium elastic nailing in pediatric femoral diaphyseal fractures. *Ind J Ortho* 2006; 40(1): 29-34.
4. Heinrich SD, Drvaric DM, Darr K, MacEwen GD. The operative stabilization of pediatric diaphyseal femur fractures with flexible intramedullary nail: A prospective analysis. *J Pediatr Orthop* 1994; 14(4):501-507.
5. Flynn JM, Hresko T, Reynolds RA. Titanium elastic nails for pediatric femur fractures: A multicentric study of early results with analysis of complications. *J Pediatr Orthop* 2001; 21:4-8.
6. Clinscales CM, Peterson HA. Isolated closed diaphyseal fractures of the femur in children: Comparison of effectiveness and cost of several treatment methods. *Orthopaedics* 1997; 20(12):1131-6.
7. Eren OT, Kucukkaya M, Kockesen C et al. Open reduction and plate fixation of femoral shaft fractures in children aged 4 to 10. *J Pediatr Orthop* 2003; 23(2):190-193.
8. Caird MS, Mueller KA, Puryear A, Farley FA. Compression plating of pediatric femoral shaft fractures. *J Pediatr Orthop* 2003; 23(4):448-452.
9. Ligier JN, Metaizeau JP, Prevot J, Lascombes P. Elastic stable intramedullary nailing of femoral shaft fractures in children. *J Bone Joint Surg (Br)* 1988; 70: 74-77.
10. Bernard Rosner. *Fundamentals of Biostatistics* 2000. 5<sup>th</sup> edition, Duxbury: 80-240.
11. Venkataswamy MR. *Statistics for mental health care research* 2002. NIMHANS publications: 108-144.
12. Sunder Rao P S S, Richard J: *An Introduction to Biostatistics, A manual for students in health sciences*, New Delhi: Prentice hall of India. 86-160.
13. John Eng, *Sample size estimation: How many Individuals should be studied?* 2003. *Radiology* 227: 309-313.
14. Sink EL, Hedequist D, Morgan SJ, Hresko T. Results and technique of unstable pediatric femoral fractures treated with submuscular bridge plating. *J Pediatr Orthop* 2006; 26(2): 177-181.
15. Saikia KC, Bhuyan SK, Bhattacharya TD, Saikia SP. Titanium elastic nailing in femoral diaphyseal fractures of children in 6-16 years of age. *Ind J Ortho* 2007; 41(4): 381-385.
16. Timothy W, Jon L, Andrew K. Compression plating for child and adolescent femur fractures. *J Pediatr Orthop* 1992; 12: 626-632.
17. Agus H, Kalenderer O, Eryilmaz G, Omeroglu H. Biological internal fixation of comminuted femur shaft fractures by bridge plating in children. *J Pediatr Orthop* 2003; 23(2): 184-189.
18. Fyodorov I, Sturm PF, Robertson WW. Compression-plate fixation of femoral shaft fractures in children aged 8 to 12 years. *J Pediatr Orthop* 1999; 19(5): 578-584.
19. Carey TP, Galpin RD. Flexible intramedullary nail fixation of pediatric femoral fractures. *Clinic Orthop Relat Res* 1996; 332: 110-118.

## ORIGINAL ARTICLE

20. Moroz LA, Launay F, Kocher MS et al. Titanium elastic nailing of fractures of the femur in children. J Bone Joint Surg (Br) 2006; 88: 1361-1366.

### **AUTHORS:**

1. Ramasubba Reddy M.
2. Srinivasa Reddy Datla.
3. Priyank Uniyal
4. Rakesh Reddy

### **PARTICULARS OF CONTRIBUTORS:**

1. Consultant Orthopedic Surgeon, Department of Orthopedics, Mallya Hospital, Bengaluru.
2. Registrar, Department of Orthopedics, Mallya Hospital, Bengaluru.
3. Registrar, Department of Orthopedics, Mallya Hospital, Bengaluru.

4. Resident, Department of Orthopedics, Mallya Hospital, Bengaluru.

### **NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:**

Dr. Srinivasa Reddy Datla,  
Registrar, Department of Orthopedics,  
Mallya Hospital,  
No. 2, Vittal Mallya Road,  
Bengaluru-560001.  
E-mail: drsreddydatla@gmail.com

Date of Submission: 03/08/2015.  
Date of Peer Review: 04/08/2015.  
Date of Acceptance: 05/08/2015.  
Date of Publishing: 07/08/2015.