Section: Orthopaedics

Research

RETROSPECTIVE STUDY OF THE CLINICO-FUNCTIONAL AND RADIOLOGICAL OUTCOME ANALYSIS OF FLEXIBLE INTRA-MEDULLARY NAIL OR ELASTIC STABLEINTRA-MEDULLARY NAILING TECHNIQUE IN MANAGEMENT OF SHAFT OF FEMURFRACTUREIN CHILDREN AGED BETWEEN 5 TO 16 YEARS

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Abstract

Background: Diaphysis Femoris" bony Cortico-Medullary Disruption represents around to 2% of the bony injury, encountered in the paediatric population. The traditional treatment has been dictated primarily by the age of the child or an adolescent sustaining the injury, its location, and the fracture geometry. **Objectives:** To analyze the Clinico-Functional & Radiological Analysis, of FIN otherwise called ESIN, surgical interventional technique, in the management of Shaft of Femur Fracture, in the children "Aetus Coetus" in School going children 5-15 years. **Materials and Methods:** This retrospective study analyzed the Clinico-Functional & Radiological Outcomesof67 patients, surgically operated for Cortico- Medullary Bony Disruption of Diaphysis Femoris, in "Aetus Coetus" in the range of V to XVI years. (School Going Aetas Span), using Flexible Intra-Medullary Nail (FIN), otherwise called Elastic Stable Intra-Medullary Nailing (ESIN), done at Trichy SRM Medical College Hospital and Research Centre, SRM Nagar, Irungalur, Trichy – 621105 from January 2017 to December 2021. SPSS was used for analysis. **Result:** The study was male preponderance and the most common age group is 9 to 12 years (40.29%). 77.60 % were males. most common seen in 29.85% followed by 32: A2 in 23.88% which is significant. 32: B1 was most common seen in 29.85% followed by 32: A2 in 23.88% which is significant. The most common for bony union was 8 weeks seen in 31.34% followed by 6 weeks in 29.85% of patients but this was not significant. Post-operative assessment based on TENS showed excellent recovery in 46.27% of patients and satisfactory in 41.79%. **Conclusion:** Choice of the right diameter of the nail and matching of a similar size pair are extremely important for achieving heartening results.

INTRODUCTION

Diaphysis Femoris" bony Cortico-Medullary Disruption represents around 1 to 2 % of the bony injury, encountered in the paediatric population.[1] The traditional treatment has been dictated primarily by the age of the child or an adolescent sustaining the injury, its location, and the fracture geometry.[2] Study by Irani R.N et al; and Henderson O.L. et al; had been emphatic in stating that, given the propensity of rapid course of the fracture healing and the inherent ability for correction of any residual deformity, these fractures in the School Going "Aetas Span" should preferably be treated, either immediately by hip spica cast or immobilised secondarily after a period of traction.[3] However,

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advances in the Implantology in Orthopaedics, have made much water flow under the bridge. It is now, being increasingly realised that, in these fractures, Operative Methodology of Stabilisation is Mandated because, even if Acceptable Reduction is achieved, preliminarily by traction, maintenance of such reduction usually fails even after immobilization. Further, when such fractures are compounded, with the fracture being opened or associated with other skeletal injury and head injury, protracted period of recumbency is neither advisable; this is the view of McCortney De et al; and Skak SV et al.[4,5] Presently there is little disagreement, states Clinkscales CM et al; for treating femoral fractures in children who are less than 5 year and adolescents who are more than 16 years. It is in this grey zone, in the "Aetas coetus", in the range of V to XVI years, where no clear cut, surgically preferred methodology of the treatment consensus exists.[6] Patients (school going children) in this intermediate "Aetas Span", have a propensity for a higher risk of bone shortening and malunion, of the fracture, if conservative treatment modality, are being opted for. Furthermore, in this "Aetas Span" prolonged immobilization mandated by conservative management, is not very much patient complaint. It was the Nancy group in 1979 who popularized the FIN/ESIN nail for Cortico-Medullary Disruption, of the Diaphysis Femoris, that has gained popularity with consistently good surgical outcome in the last 4 decades.[7] Either be it, the ESIN nail or the Malleable IM Nail (FIN/Ender Nail), they serve as an internal splint, which are not only load sharing, but maintain good reduction, until achieving sound bony union, with the added advantage, of neither disturbing the growth zone nor interfering with the blood supply to the femoral head.[8] Malleable IM nailing (FIN) has been propitiously used to treat these particular "Aetas Span" of School Going Children.[9,10,11,12] These Flexible Stainless-Steel Intramedullary Nail (FIN) and Titanium ESIN nail, vary in their composition of Nail Metallurgy, the study by Crawfold et al.[13] found no significant difference of fracture healing outcomes. Our study shall aim to analyse the potency of FIN/ ESIN nail, in surgically intervening Femoral Diaphyseal Fracture of School Going Children in" Aetus Coetus" in the range of V to XVI years.

Aim

This Retrospective Study Aims, to analyze the Clinico-Functional & Radiological Analysis, of FIN otherwise called ESIN, surgical interventional technique, in the management of Shaft of Femur Fracture, in the children "Aetus Coetus" in the range of V to XVI years (School going children), with a special thrust to understand their Technical Nuances, Intra-Operative Time, Intra-Operative Blood Loss, Intra- Operative Complications & post-operative short to medium range complications.

MATERIALS AND METHODS

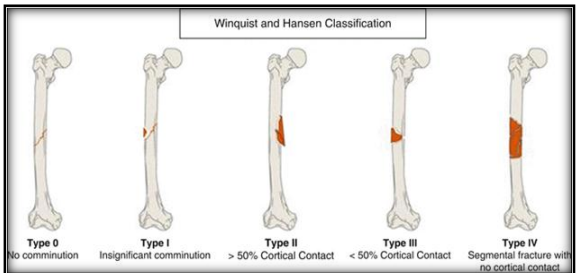
This retrospective study analyzed the Clinico-Functional & Radiological Outcomesof67 patients, surgically operated for Cortico-Medullary Bony Disruption of Diaphysis Femoris, in "Aetus Coetus"in the range of V to XVI years. (School Going Aetas Span), using Flexible Intra-medullary Nail (FIN), otherwise called Elastic Stable Intra-medullary Nailing (ESIN), done at Trichy SRM Medical College Hospital and Research Centre, SRM Nagar, Irungalur, Trichy – 621105 from January 2017 to December 2021.There was a minimum follow up period of 1 year (Range:24 to 59 months, Mean:32 months). Hence patient recruitment was limited to, until December 2019. Thus, this study was spanning across a time interval of 5 years of which, the initial 4 years alone was considered to be a recruitment period and subsequent 1 year, was limited to systematic follow up of the cases, which were operated, during the period of recruitment.

Inclusion Criteria

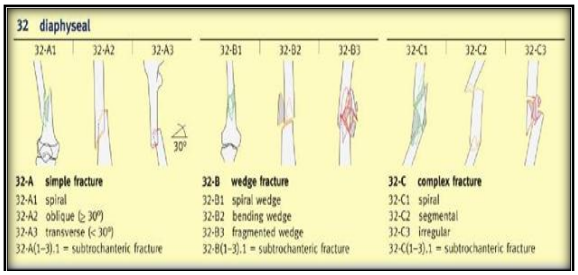
- "AetusCoetus" in the range of V to XVI years of either sex having aCorticoMedullary Disruption of the Diaphysis Femoris, conforming to the geometricalfracture outlay, (Winquistand Hansen'sType0, I II&IIIor AO/OTA 32: A1, A2, A3and32: B1andB2.

Exclusion Criteria

- Comminuted and Segmental fractures (Winquist and Hansen pattern Type IV or AO/OTA32:B3,32:C1, C2, C3).
- FractureinvolvingtheDistalandProximal1/5thofth efemoralshaft.
- Pathological fractures of femur, as a result of a metabolic disorder or conditions like osteogenesis imperfect a, metastases etc.



Winquist And Hansen's Femoral Shaft Fracture Classification.[14]



AO/OTA Classification Of Femoral Diaphyseal Fractures.[15,30]

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Pre-Op Evaluation

The fractures were classified both as per Winquist and Hansen & as per AO/OTA classification.

Pre-Op Protocol

All the Patients who arrived at the Emergency Casualty Center of TRICHY SRM Medical College Hospital & Research Centre, (formerly known as Chennai Medical College Hospital & Research Centre), affiliated to The Tamilnadu Dr.M.G.R. Medical University, and satisfying our inclusion criteria were included. After the preliminary stabilization of the patient by Advanced Trauma Life Support (ATLS) and necessary Hemodynamic and Electrolyte Imbalance Correction, the fractured limb was immobilized in a well-padded Thomas Splint, of an appropriate length and diameter and further Tobruked16 using a four-inch elastic crepe bandage. And shifted for necessary radiological survey which included systematic imaging of both the hip joints, with the pelvis above and the knee joint below. If there were any suspicion of Abdominal/Chest/Head injury, then relevant imaging investigations were sought concurrently and specialist opinion from respective specialty were sought forthwith.

Surgical Modus Opreandi

Nail preference for ESIN/FIN

ESIN nails are usually available up to a length of 4.4 cm & have a diameter range from 1.5 mm to 4 mm, further they are Color Coded, for ease of identification (Figure 1). Nail diameter was calculated by Kasser and Beaty formula; Nail Size=Internal Canal Diameter/2 minus 0.5 mm17. In the "Aetas Span" of 6 to 8 years, 3mm diameter nails, for the Aetas span 9 to 11 years 3.5mm diameter nails and in the Aetas Span of 12 to 16 years, 4mm diameter nails were usually found to be accommodatable. Care was taken to ensure that the Dual Nail that where Intra-Medullarily Inserted, had exactly the same diameter, which could ensure equal opposing bending forces, within the medullary canal, thus preventing any chances of Malalignment, upon initiation of weight bearing. For achieving the best clinical outcome, we adhered to the properties which were laid down by Deitz H.et al;18 namely; Rotational stability, stability related to flexibility, stability related to axial loading, and Translational stability [Figure 2].

Procedure

Step 1: Surgical positioning of patient [Figure 3]

A radiolucent table, along with the C arm, was used for the observation of adequate reduction, following which, the fractured limb was prepped and draped.

Step 2: Pre bowing of the nail

Contouring was done, with the help of the nail bender, to approximately 30 degrees. Care was taken to keep the nail bending to be in coincidence with that of the other in the pair.

Step 3: Choosing the nail entry point and the nail size

The entry points of the nail, were so chosen, on both the lateral and medial tops of the Femoral Condylar Flare. The incision was placed, at least 30 mm surpassing the lower femoral growth plate, which was done under vision of the C arm. The drilling was done perpendicular to the outer cortex of the femoral bone and the hole enlarged with the help of a curved Femoral Awl, angulated to approximately 45 degrees, towards the Proximal Femoral End. This entry point was created successively, on both the lateral and medial femoral flares, always ensuring, that the femoral drill bit did not angulate or slip in a posterior ward direction, for the fear of impaling the femoral artery. The nail size was predetermined by the Kasser and Beaty, formula. Note that in figure 4a denotes the nail diameter and '4b' denotes the canal diameter. Proximal entry point: [Figure 4] In selective distal 3rd Diaphyseal Fractures, one may have to opt for a Proximal Entry of the nail, in order that the Distal Closed End of the nail Fans out and Skirts the outer inner borders of the Medial and the Lateral Femoral Condyles, in order to maintain femoral axial and rotational alignment.

Step 4: Nail introduction and femoral fracture reduction [Figure 5]

Both the elastic nail are introduced, one after another, and propagated to approach the fracture site, in such a way that the convex side of the nail, which were already pre-bent, as visualized in the C arm, shall be glancing off the far cortex. If there is encountered any difficulty, at achieving adequate reduction by manual manipulation, then the radiolucent F- tool [Figure 6] was used to achieve the reduction, having successfully negotiated both the nails, beyond the fracture site and positioned at least 20 to 30 mm superior to the fracture, rotation of the nail was carried out. This procedure was carried out, for the one nail, and this nail was advanced further proximally but not beyond 5 to 6 cm proximal to the fracture site. Having achieved this feat, the other nail was propagated proximally, subsequent to rotation.

Step 5: Decision on proximal level of nail placement and distal nail cutting [Figure 7]

At this juncture, traction, if any are released and both the nails were advanced proximally by propagating the nail in a step-by-step fashion, by alternating the sides of the nail, that is being propagated. At this stage care was taken to clinically determine whether there was any translational instability, axial instability, or flexural instability. Malrotation were also have to be corrected at this stage. If any Malrotation was noted, then the nailing were removed first and redone subsequently. The distal end of the nail was cut, atleast 15 mm to 20 mm, so that they would lie beyond the cortex and they were bent. Wound closure was carried out after a Povidone Iodine wash, followed by a saline wash. Wound was closed in layers and skin closed with surgical suture clips. Sterile dressing was then applied

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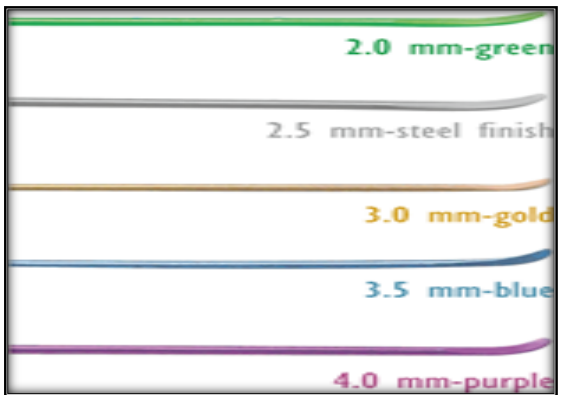

Figure 1: TENS Nail color coding

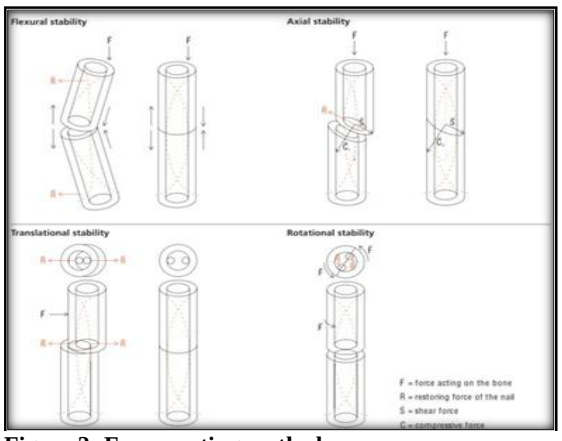

Figure 2: Forces acting on the bone

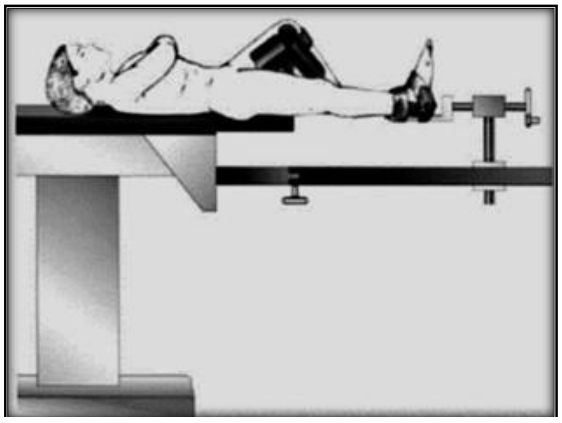

Figure 3: Position

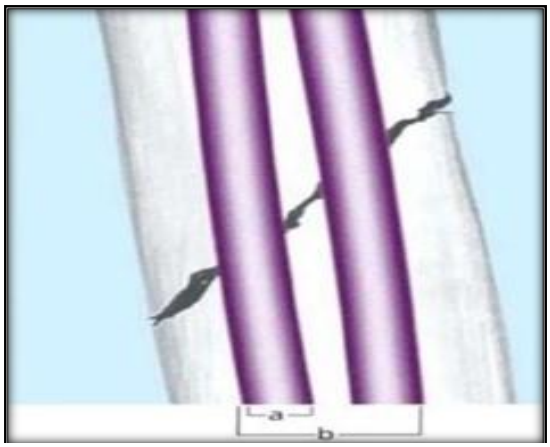

Figure 4: Nail diameter as calculated by the formula of Kasser and Beaty

Figure 4: Proximal & Distal Entry point

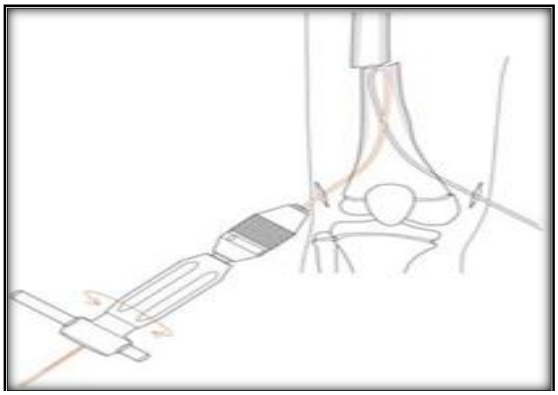

Figure 5: Nail introduction and fracture reduction

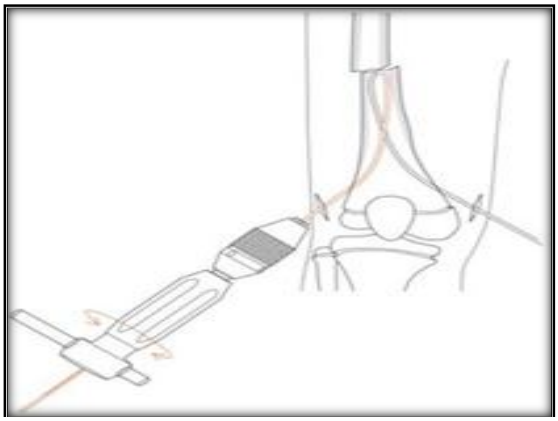

Figure 5: Nail introduction and fracture reduction

Figure 6: F-Tool being used for Manipulation and Reduction

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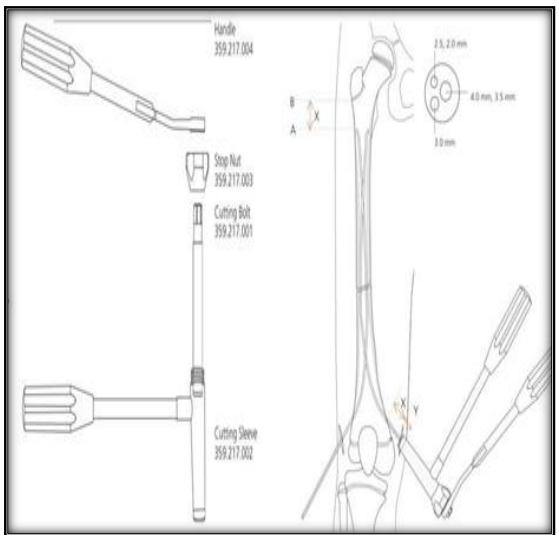

Figure 7: Nail end Cutting and Bending

Post Op Protocol

Being in the pediatric aetas span all the patients who were operated upon were shifted to the pediatric post op ICU and the Hemodynamic plasma, Electrolytes, Input Output vitals were all monitored meticulously. Post Op Analgesia was handled by the pediatric anesthetist specialist, which was for the First Twelve Post Op Hours, with the help of spinal epidural anesthetic pump. Here again for sedation, the same anesthetic team decided on the choice and dosage of appropriate sedatives. If the fracture were found to be little bit unstable under C arm Post Fixation, in the OT, gentle skin traction with compression of the Ipsilateral and Well Leg Traction, were instituted. IV antibiotics were a combination of Ceftriaxazone Sodium with Gentamycin/Amikacin combination, whose dosage were titrated for Age and Weight, by the Pediatrician and administered for the First 48 hrs. Post Operatively. If the condition of the child/adolescent were found to be satisfactory, after 24 hrs. post- surgery they were shifted to the regular ward. From day 2, Gentle Active Assisted Hip Knee Ankle Foot Mobilization, were encouraged and monitored by professional pediatric physiotherapist. Ipsilateral lower leg compression bandage from Mid-thigh to toe, were however maintained for the First 3 days. The First Post Op wound dressing were done on POD 3. The ROM Exercise for The Hip, Knee, Ankle and Foot were encouraged and increased in a range as was best tolerated by the patient. From POD 3, Non Weight Bearing Walker Ambulation, were encouraged. Suture removal were done on POD 12. Unless specifically warranted, no oral antibiotics were initiated following cessation of IV antibiotics. Oral analgesics in the form of Ibuprofen and Paracetamol, were initiated in Post Op period. They were discontinued from POD 12. For augmenting the process of fracture healing, syrup Calcium combined with Vitamin D, Syrup Amino Acid, Vitamin C and Folvite were continued for 3 months, Post Operatively. If at the expiry of the IIIrd week post surgically, the X-ray were encouraging and confirmative of Stable Fixation, Toe Touch Ambulation was initiated. Usually, FWB were withheld up-until the 6th week Xray were encouraging. After the 10th week Post Operatively, Child/Adolescents, were permitted to go to school, but were asked to abstain from activities such as Cycling, Running and Jumping and Participation in Contact Sporting Activities.

Follow Up Protocol

Radiological Evaluation were done for assessing the progress of fracture healing, and Clinico-Functional parameters were recorded at the end of 3, 6, 9, 12 and 15 weeks. If Sound Radiological Evidence, were visualized along with clinically painless good union, then the patient was called for the review, only at the end of 6th month Post Op. At this stage Flynn JM et al;[19] scoring criteria and Anthony's Radiological criteria were Evaluated and Tabulated. The final follows up was the end of 6th months Post Operatively.

Clinical-Functional outcomes were evaluated according to the Tens Scoring

System used by Flynn's Scoring Criteria and the Radiological outcomes were done,

as per Anthony's Radiological Criteria.

Table 1: FLYNN scoring criteria for TENS

	Excellent	Successful	Poor
Limb length discrepancy	< 1.0 cm	1 to 2 cm	>2 cm
Sequence disorder	5 degrees	10 degrees	>10 degrees
Pain	Absent	Absent	Present
Complication	Absent	Mild	Major complication or increased morbidity

Table 2: ANTHONY' Radiological Criteria for TENS

Grade 0	No identifiable fracture healing.
Grade 1	Primary bone healing with little or no periosteal new bone formation.
Grade 2	Periosteal new bone formation on two sides of the femur.
Grade 3	Periosteal new bone formation on three or four sides of the femur.

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RESULTS

Table 3: Age and Sex Distribution

Age in years	Male 'n' % age		Female 'n' % age		Total 'n' % age	
5 to 8	13	19.40 %	3	4.48	16	23.88 %
9 to 12	23	34.32 %	4	5.97	27	40.29 %
13 to 16	16	23.88 %	8	11.95	24	35.83 %
Total	52	77.60 %	15	22.40 %	67	100 %

Table 4: Mode of Injury

Nature of trauma	No of cases 'n'	Percentage (%age)
RTA	37	55.22 %
Fall while playing	23	34.33 %
Fall from height	7	10.45%
Total	67	100 %

Table 5: Ratio of the Sidedness, level of Fracture, Type of Fracture and Pattern of Fracture

Parameter	Description	Ratio
Sidedness	Right:Left	37:30
Level of fracture	Proximal third: Middle third: Distal third	27:21:19
Type of fracture	Closed fracture: Open fracture	60:7
Pattern of fracture	Transverse: Oblique: Spiral	47:13:7

Table 6: AO/OTA Types of Fractures

Fractue Type	No of cases 'n'	Percentage (%age)
32:A1	6	8.95 %
32:A2	16	23..88 %
32:A3	12	17.91 %
32:B1	20	29.85 %
32:B2	13	19.41 %
Total	67	100 %

Table 7: Winquist Hansen's Type of Fracture.

Fractue Type	No of cases 'n'	Percentage (%age)
O	6	8.96 %
I	28	41.79 %
II &III	33	49.25 %
Total	67	100 %

Table 8: Associated Injury

Head Injury	7	10.45 %
Abdominal Injury	4	5.97 %
Ipsilateral Tibia	3	4.48 %
Pelvic fracture	4	5.97 %
Other upper limb injury	5	7.46 %
Total	23	34.33 %

Table 9: Time Interval elapsed between Trauma and Surgery

Duration in days	No of cases 'n'	Percentage (%age)
<24 hours	30	44.78 %
2-4 days	17	25.37 %
5-7 days	10	14.93 %
8-10 days	07	10.45 %
11-13 days	03	4.47 %
Total	67	100 %

Table 10: Type of Reduction

Reduction method	No of cases 'n'	Percentage (%age)
Closed	60	89.55 %
Open	07	10.45 %
Total	67	100%

Table 11: Stay in Hospital

Hospital Stay	No of cases 'n'	Percentage (%age)
3-5 days	27	40.30 %

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6-8 days	17	25.37 %
9-11 days	16	23.88 %
12-14 days	7	10.45 %
Total	67	100 %

Table 12: Time for Bony-Union.

Time for union	No of cases 'n'	Percentage (%age)
6 weeks	20	29.85 %
8 weeks	21	31.34 %
10 weeks	14	20.90 %
12 weeks	12	17.91 %
Total	67	100 %

Table 13(a): Minor Complications.

Time for union	No of cases 'n'	Percentage (%age)
6 weeks	20	29.85 %
8 weeks	21	31.34 %
10 weeks	14	20.90 %
12 weeks	12	17.91 %
Total	67	100 %

Table 13(b): Major Complications.

Complications	No of cases 'n'	Percentag e (%age)
Varus Angular Malalignment >10 Degrees	6	8.96 %
LLD above 2cm	4	5.97 %
Non-union	0	0 %
Total	10	14.93 %

Table 14: Final post-operative assessment based on FLYNN JM et al; Criteria for TENS, Evaluated at 6-month Post Operatively.

Criteria	No of cases 'n'	Percentage (%age)
Excellent	31	46.27 %
Satisfactory	28	41.79 %
Poor	8	11.94 %
Total	67	100 %

Table 15: Final Post-Operative assessment based on ANTHONY'S Radiological Criteria, Evaluated at 6-month Post Operatively.

Grade	No of cases 'n'	Percentage (%age)
Grade 0	0	0 %
Grade 1	6	8.96 %
Grade 2	14	20.90 %
Grade 3	47	70.14 %
Total	67	100 %

Case I llustrations

Case 1: Pre Op. **Immediate Post Op.** **6th month Follow Up.**

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Case 2

Pre Op. **Immediate Post Op.** **6th month Follow Up.**

Case 3: Pre Op. **Immediate Post Op.** **6th month Follow Up**

DISCUSSION

Table 16: Comparison with other studies.

Parameters	Our study	Pooja Suratwala et al;[20]	Mohammed et al;[21]	Santosha et al;[22]	Jyotirtmayee et al;[23]	Ramprakash et al;[24]	Roop et al;[25]	Rajesh et al;[26]
Number of victims in the study	67	20	10	30	25	73	35	48
Flynn Criteria								
Excellent	31	9	10	20	19	59	25	40
Satisfactory	28	8	0	9	4	10	8	8
Poor	08	3	0	1	2	4	2	0
Average Hospital Stay in Days	7.13 Days	9.6 Days	7 Days	15.23 Days	7 Days	5.1 Days	12.30 Days	7.3 Days
Mean surgical time	56 Min	66 Min	45 Min	59 Min	60.75 Min	67 Min	63 Min	65 Min
Average time for sound bony Union	8.53 Weeks	9.4 Weeks	Weeks	11.8 Weeks	7.9 Weeks	10.2 Weeks	9.6 Weeks	Weeks
Side								
Right	37	11		18			20	
Left	30	9		12			15	
Level								
Proximal	27	8	6	18	16	51	7	7

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Middle	21	12	2	7	6	17	28	36
Distal	19	0	2	5	3	5	0	5
Parameters	**Our study**	**Pooja Suratwala et al;[20]**	**Mohammed et al;[21]**	**Santosha et al;[22]**	**Jyotirtmayee et al;[23]**	**Ramprakash et al;[24]**	**Roop et al;[25]**	**Rajesh et al;[26]**
Pattern								
Spiral	7	2	2	2	4	0	0	6
Oblique	13	4	2	3	7	21	0	12
Transverse	47	14	5	16	11	49	15	24
Comminuted	0	0	0	2	3	3	0	0
LLD	4/67	1/20	0/10	2/30	6/25	13/73	3/35	5/48
Malalignment	6/67	2/20	0/10	1/30	4/25	11/73	3/35	4/48
Nail end irritation due to protrusion	8/67	3/20	0/10	0/30	2/25	2/73	5/35	12/48
Average time in weeks PWB	5.2 Weeks	6 Weeks	4 Weeks				4.56 Weeks	
Average time in weeks FWB	9.5 Weeks	8 Weeks	11.2 Weeks			10.5 Weeks	8.3 Weeks	Weeks
Average time for Return to school	10 Weeks	8.5 Weeks					7.8 Weeks	Weeks

With regards to age and sex distribution,76.11% (n= 51), belonged to the Aetus Span of 5 to 16 years, we had a Male: Female ratio of 52:15. Majority of our cases had RTA as the mode of the injury [55.22% (n =37)]. Right sided injury slightly was on the higher side of incidence, similarly the proximal third fractures were among the commonest. 34.33% (n=23), of our cases had an associated injury. Our average time interval, between occurrence of trauma and the timing of surgery was at 3.58 days. In 89.55% (n =60) cases, we could achieve closed reduction while in 10.45% (n=7), we had to opt for a mini-open reduction, due to muscle tissue interposition. Our average intra-operative blood loss was 45 ml (Range 35 to 66 ml). Our patients, had an average in-patient staying for 7.13days. Our average time for Sound Bony Union was at 8.53 weeks, while 20.90% (n=14) cases of ours suffered, minor complications. We did not have, any case of implant failure, deep infection, requiring nail removal, nor did we have any case of non-union in our series of 67 patients. 49.25% (n=33), cases had been of the 32B1 or B2 type variant of AO/OTA or of the Type II or III of the Winquist Hansen's type. Our study population of 67 patients compares closely with the study of Ramprakash et al.[24] who had in their study,73 patients. Our Flynn JM et al.[19] criteria outcomes matched most closely with that of the study of Pooja Suratwala et al.[20] Our average hospital stays of 7.13 days matched the study of Rajesh et al.[26] and Jotirmayee et al.[23] Our average operative time was 56 minutes which was compares well with the study of Roop et al.[21] Jyotirmayee et al.[23]; and Santosha et al.[22]

Our distribuition of sidedness, matched the study of Pooja Suratwala et al.[20], Santosha et al.[22], and the study of Roop et al.[25] The distribution of the level of fracture was unique, compared to the other contemporary studies and the dominant distribution was of the proximal type variant. Our fracture pattern, distribution matched well with the pattern of Pooja Suratwala et al.[20] Santosha et al.[22] and Jotirmayee et al.[23] Our LLD statistics, also matched with that of the study of Roop et al.[25] and Pooja Suaratwala.[20] Malalignment statistics of Roop et al.[25] and Pooja Suratwala et al.[20] matched well with those encountered in our series. Nail end irritation due to protrusion, in our series, matched well with those reported by Pooja Suratwala et al.[20] and Roop et al.[25] Our average time for Partial weight bearing of 5.2 weeks matched that of Pooja Suratwala et al;20, Roop et al.[25] and Rajesh et al.[26] Our average time for full weight bearing at 9.5 weeks matched best with the studies of Ramprakash et al.[25] and Rajesh et al.[26] The time for our patients to start attending the school was on an average of 10 weeks, which compared well with the findings of Rajesh et al.[26] TENS NAIL (Titanium Elastic Nail) also called as FIN or ESIN are meant for stabilization of Diaphysis Femoris Cortico-Medullary Disruption, wherein the Intramedullary Canal Diameter, is restricted and the pliability of implant is paramount. Femoral shaft fractures are indeed, a major injury in the pediatric Aetas Span of 5 to 16 years. When in the Aetas Span of beyond 5 years, conservative treatment, is opted for many a times, there is a Loss Of Reduction, Malunion, Intolerance to the treatment and Complications are witnessed.

As we approach the termination of the Skeletal Growth Maturity, accuracy of the reduction and maintenance of reduction, are of paramount importance, as little time is left for the amelioration, of such deformities by remodeling. Over the last two decades and more, ESIN or FIN have evolved as a major choice of stabilization for Femoral Diaphyseal Fractures. The obvious advantage of employing these implants, are that they ensure early Sound Bony Union, by permitting repetitive micro-movements at the Cortico Medullary Disruption

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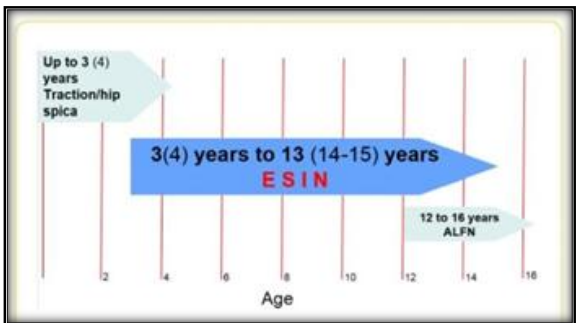
Site, permitting for early mobilization of the patients and weight bearing. Further, these surgical intervention, respects the physis and have an acceptable scar mark. These implants, exit easily and they have among the highest level of patient compliance. Femoral Diaphyseal Fractures, account for about 2% of all pediatric fractures. The ESIN or FIN, act advantageously as a simple load sharing Internal Splint, without any Physeal Violation. Micro-movements at the level of the Cortico-Medullary Diaphyseal Disruption, promotes Copious External Bridging Callus Formation. In this procedure, the periosteum is not violated and fracture hematoma is not disturbed, thereby grossly minimizing chances of infection. Flynn JM et al.[19] has started that TENS nailing has a distinct advantage over treatment with a hip spica. This concept was seconded by Buechsenshnetz et al.[27] who commented that flexible FIN/ESIN are superior in the pattern of achieving bony union, scar appearance, Patient acceptance and thus provides for an overall patient compliance and satisfaction in comparison to POP Casting and Traction Treatment. In the series of 123 patients treated and reported by Ligier et al.[7] all fractures did go in for sound bony union, as was in our series of 67 patients. This fact has also been highlighted by Narayanan et al.[28] Yes, both the aforesaid studies have reported, nail entry site protrusion irritation, which was also witnessed in our series, accounting for 11.94%(n=8). These minor complications were sorted out, upon nail removal, usually done at 6 months Post-Op. Flynn JM et al.[19] Narayanan et al.[28] and Lascombes et al.[29] all have concurred on the safety and utility of use FIN/ESIN, in surgically addressing Diaphysis Femoris Bony Cortico Medullary Disruption, in the Aetas Coetus, of our inclusion criteria. They were also prompt to point out that FIN/ESIN must not be considered for comminuted open Type III Diaphysis Femoris Bony Cortico Medullary Disruption, as they shall fail to provide for adequate fracture site stability. This was the reason, that we excluded such a fractures from our inclusion criteria. Thus overall, if strict inclusion criteria parameters are mandated for FIN/ESIN, the results are very much reproducible and gratifying.

CONCLUSION

The ESIN or FIN have been time tested to provide a predictability of good functional and the Roentgenographic Outcome, in selective cases of Femoral Shaft Fractures. It has good patients compliance, lower rates of complications and little or no danger to the Physeal Wellbeing.



This graphic representation shows evidence based current and worldwide accepted concepts of treating Pediatric Diaphysia Femoris. It is obvious that the FIN/ESIN Methodology of surgical intervention successfully spans a long age group between 5 and 16 years of age31,32,33. Choice of the right diameter of the nail and matching of a similar size pair are extremely important for achieving heartening results. Such diameters mismatch can have consequences of fracture site varus or valgus angulation. Choice of patients age, correct choice of fracture pattern, nail diameter, mirror pairing are paramount to achieving excellent Clinico-functional and radiological outcomes. Funding Information: The cost of all the surgeries for the subjects where funded by the patients themselves and funding for the Original Research Article was by the authors themselves.

Complaince with Ethical standards

IRB & IEC approval from Trichy SRM Medical College Hospital and Research Centre was obtained from the Institutional Research Board. Written consent was obtained from the parents of the children, that the data collected in the form of Xray reports and clinical data shall be used for the purpose of Scientific Research Publications, without exposing in any manner, the privacy of the patient

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