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Original Research

A Prospective Cohort study to compare Clinico-radiological outcomes of Antegrade vs Retrograde TENS Nailing for Paediatric Tibia shaft Fractures

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ABSTRACT:
Background: Close reduction and casting which continues to be the gold standard of care, and is a successful treatment for the great majority of the paediatric tibial shaft fractures.
On occasion severe shortening, angulation or mal-rotation at the fracture site prevents reduction from being maintained necessitating surgical intervention options are external fixation, plating, flexible intramedullary nailing etc. We decided to carry prospective comparative study to compare clinico-radiological outcomes with antegrade versus retrograde TENS nailing.**Objectives:** To compare clinico-radiological outcomes with antegrade versus retrograde TENS nailing. **Methods:** Patients were operated with 26 patients in antegrade TENS nailing group and 24 patients in retrograde TENS nailing group. **Results:**There was no significant difference in both groups as regards age, sex, time required for the surgery, image intensifier time, length of incision, time required for soft tissue healing, pain etc.
Retrograde TENS nailing has better results in the management as regards incidence of delayed union. Retrograde TENS nailing has more incidence of soft tissue irritation and infections compared to the antegrade TENS nailing.
Conclusion: Retrograde TENS nailing has less incidence of delayed union and malunion and has more incidence of soft tissue irritation and infection as compared to antegrade TENS nailing
Keywords: Antegrade, retrograde, Flexible, nailing, tibia, paediatric

Introduction

Paediatric tibia fracture constitutes 10%-15% of all paediatric fractures of these 39% occurs in middle third. Most tibia fracture occurs from falls or road traffic accidents or indirect sporting injuries.
Close reduction and casting which continues to be the gold standard of care, and is a successful treatment for the great majority of the paediatric tibial shaft fractures. However, on occasion severe shortening, angulation or mal-rotation at the fracture site prevents reduction from being maintained necessitating surgical intervention. [1,2] Options for surgical interventions include flexible intramedullary nailing, external fixation (compound fractures, severe comminuted fractures, soft tissue orassociated vascular injury), plating and rarely locked intramedullary nailing in older children (after or near physeal closure). Complications of paediatric tibia fractures include malunion, growth arrest or over growth, delayed or non-union and compartment syndrome. However, complications are a rare due to ability of young children to remodel and heal rapidly. Because of its clinical efficacy and low risk of sequelae, elastic stable intramedullary nailing has wide acceptance. [3,4,5]
Benefits of this approach are closed insertion, micro motion induced healing, preservation of fracture hematoma and physeal sparing entry location etc. [3,6] TENS minimise the amount of permanent deformation caused by the nail implantation because they are more elastic, decrease stress shielding and are bio compatible without causing metal sensitivity reactions.[7,8] Also, titanium elastic nails provide biomechanical stability from its prebend 'c' configuration which provides stable 3-point fixation and are load sharing devices.[9,10]
For Tibia fractures particularly more distal shaft fractures TENS nails can be placed antegrade or retrograde. However, antegrade nailing for distal tibia fractures is challenging and bears risk of primary and secondary mal-alignment. [11] Otherwise, antegrade nailing for tibia is generally preferred. When

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skeletonis almost fully developed, nails can be put even percutaneously into the medial malleolus and across physis. [12]

However, there are no conclusive studies published as to which approach is better for TENS nailing in paediatric tibia fractures. Hence, we carried out research on this topic. We decided to carry prospective comparative study to compare clinico-radiological outcomes with antegrade versus retrograde TENS nailing.

Materials and Methods:

Prospective comparative cohort study was carried out at our tertiary care hospital. Institutional ethics committee approval was taken and consent for participation in study along with assent if applicable was taken from patients and their parents. Patients presenting themselves for the first time in OPD and casualty with fresh Tibia fractures (less than one week old) and satisfying inclusion and exclusion criteria were included in the study. Surgical plan of both antegrade and retrograde TENS nailing were discussed, if nailing was preferred operative technique by the operating surgeon with parents/guardians of the patient. 50 patients were operated with 26 patients in antegrade TENS nailing group and 24 patients in retrograde TENS nailing group. Patients with pathological fractures, compound fractures, intraarticular fractures, wedge fractures of the tibia and segmental fractures of the tibia were excluded from the study.

Patients were taken up for surgery after preliminary investigations,anti-inflammatorymedicines, splinting and after getting fitness for the surgery.

Patients were operated under general anaesthesia in supine position on radiolucent table under C arm guidance. Appropriate sizes TENS nails were prebend into the 'C' shape and passed and inserted into intramedullary cavity after close reduction from the entry points made with bone awl. After nails reached fracture site and close reduction was done under image intensifier guidance, nail was advanced into distal/ proximal fragments depending upon whether it was antegrade or retrograde technique. Wounds were closed and padded with gauze. Physiotherapy was started from second post operative day of the surgery and discharged as soon as possible. Suture removal was done on the 12th or 14th day. Patients were followed up at 6 weeks, 3 months and 6 months and assessedclinic-radiologically.

Modified criteria of Flynn were used to categorise outcomes /results as excellent / satisfactory or poor depending upon leg length discrepancy, malignment, pain, complications.

Results

	Antegrade TENS	Retrograde TENS
Mean Age in years are	10.9 years	10.6 years
Mean Sex in both genders are	M-18, F-8	M-17, F-7
Mean Time required for surgery is	28.4 mins	28.1 mins
Mean Time required for wound healing is	7.4 Days	9.2 Days
Mean Image Intensifier time in Minutes is	16.2 mins	14.3 mins
Mean Length of Incision is	2.4 cm	2.2 cm
Mean Time for union is	10.1 weeks	10.8 weeks
Mean mal-alignment (<5, 5-10, >10 degree) is	04(26)	01(24)
Mean Limb Length Discrepancy (<10, 10-20, >20 mm) is	0.43 mm	0.42 mm
Mean Pain (VAS Score) (None, present) are	06	07
Mean Minor Complications are:	03	04
• Delayed Union,	12	06
• Skin tissue irritation/transient superficial infection)	01	03
Mean Major Complications that disturb walking are		
• Non union	00	00
• Deep Infection	00	00

Discussion

Close reduction and plaster is the mainstay of the treatment in the paediatric tibia fracture. However surgical treatment may be indicated in open fractures, instability, secondary reduction loss, polytrauma, neurovascular injury etc. Surgical options are external fixators, locked interlocking nail in older children, minimally invasive percutaneous plate osteosynthesis, intramedullary titanium elastic nailing etc, TENS may

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cause malunion due to angulation during union, irritation or sometimes delayed union. [13,14]

There was no significant difference in both groups as regards age, sex, time required for the surgery, image intensifier time, length of incision, time required for soft tissue healing, pain etc.

In the study by **Uludag et al** mean time for union was 11 weeks. [15]

In study by **Onta et al** mean time was 13.3 weeks. [16]

Shen et al reported radiological time for union was 9.6 weeks. [17]

Kc et al reported mean union time of 11.17 weeks. [18]

In our study mean time for union was 10.1 weeks in the antegrade nailing group and 10.8 weeks for the retrograde nailing group. Thus, findings of our study were comparable with the literature.

Fracture location is a limiting factor for implant selection in paediatric tibia fractures. Flexible intramedullary nailing is a good option but has limited stability when applied to the proximal or distal Tibia. About half of the cases of paediatric tibia fractures in our study in antegrade TENS nail group (12 out of 26) and (12 out of 24) in retrograde TENS nail group where either proximal or distal tibia fractures. Though we had excluded intra-articular fractures. In this group of patients, we got better results in retrograde TENS nailing group as regards malunion and delayed union. This is probably the result of the anatomy of Tibia which is triangular in cross section proximally but more rectangular in cross section distally. Hence use of flexible nail entry point in proximal tibia though not difficult may lead to malunion in more cases as compared to the distal entry points as regards valgus or recurvatum deformity. In study by the **Srivastava et al** there was 8% rate of malunion after antegrade nailing. [19] Our study result shows (4/ 26) cases for in antegrade nailing group showed more than 10° Mal-alignment that is in 15.38% cases.However, in retrograde TENS nail group only 10 out of 24 patients showed malunion > 10° that is in 4.16% patients only.

As regards delayed union in antegrade nailing group 12 out of 26 patients had not united at 3 months as compared to 6 out of 24 patients who had not united in retrograde TENS nailing group at 3 months. However, all patients united at follow up at 6 months in both the groups. Thus, delayed union was more seen in the antegrade nailing group. This also could be due to better stability based on nail entry points at proximal and distal as discussed in earlier paragraph on malunion.

Gordon et al reported high incidence of delayed union after antegrade flexible nailing. [20] Also, they noted hypertrophic bone formation in these patients consistently with less stability with antegrade TENS nailing. This was consistent with our study. Study by **Kc et al** had delayed union in 4 out of 45 patients operated by antegrade TENS nailing technique. **Shen et al** reported delayed union in 2 out of 21 patients operated by antegrade TENS nailing technique.

As TENS nailing is minimally invasive procedure done under image intensifier guidance overall complication related to invasive surgeries like plating were significantly less like soft tissue irritation or infection. However superficial infection or soft tissue irritation was observed in 8 patients in retrograde nailing group and 4 patients in antegrade nailing group. In study by **Uludag et al** 6 out of 20 patients reported irritation or infection due to antegrade TENS nailing. **Onta et al** reported 4 out of 18 patients had irritation or infections due to TENS nailing. **Kc et al** reported 6 out of 45 patients had skin irritation or infection due to nailing. Thus, our results are consistent with literature but the superficial infections or soft tissue irritation was more in retrograde nailing as compared to antegrade nailing group probably because in retrograde nailing technique lateral nail entry point needs some dissection of soft tissue and tendons. We did not get any deep infection.

Average limb length discrepancy was observed of 4.3 mm in antegrade nailing group and 4.2 mm in retrograde nailing group and there was no significant difference in both the groups as regards to this complication.

This is in accordance with study by **Walamastha et al** who found leg discrepancy of < 15 mm in 3.6% operated with TENS.[21]

Conclusion

1. Close reduction and intramedullary fixation with TENS provide favourable outcomes in the treatment of the unstable paediatric tibia shaft fractures that cannot be treated by conservative methods.
2. Both antegrade and retrograde methods of TENS insertion have good results in the management of paediatric tibial fractures.
3. Retrograde TENS nailing has better results in the management of proximal or distal extra articular tibial fractures as compared to the antegrade TENS nail insertion as regards incidence of delayed union.
4. Retrograde TENS nailing has more incidence of soft tissue irritation and infections compared to the antegrade TENS nailing.

Limitations of the study

Our sample size was small and our study was not randomised.

We had excluded compound fractures and pathological fractures from this study

References:

1. Sankar WN, Jones KJ, David Horn B, Wells L. Titanium elastic nails for pediatric tibial shaft fractures. Journal of children's orthopaedics. 2007 Nov;1(5):281-6.
2. Salem KH, Lindemann I, Keppler P. Flexible intramedullary nailing in pediatric lower limb

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fractures. Journal of Pediatric Orthopaedics. 2006 Jul 1;26(4):505-9.
3. Carey TP, Galpin RD. Flexible intramedullary nail fixation of pediatric femoral fractures. Clinical Orthopaedics and Related Research®. 1996 Nov 1;332:110-8.
4. Liu P, Wei Z, Wei YX, Sun WX, Li HW, Huang S, Zou W. Treatment of children-s shaft fracture of tibia and fibula with ESIN fixation. OJPed. 2011 Jun 17;1:9-11.
5. Kubiak EN, Egol KA, Scher D, Wasserman B, Feldman D, Koval KJ. Operative treatment of tibial fractures in children: are elastic stable intramedullary nails an improvement over external fixation?. JBJS. 2005 Aug 1;87(8):1761-8.
6. Byanjankar S, Shrestha R, Sharma JR, Chhetri S, Dwivedi R. Titanium Elastic Intramedullary Nailing in Paediatric Tibial Shaft Fractures. Orthop Muscular Syst. 2018;7:255.
7. Flynn JM, Hresko T, Reynolds RA, Blasier RD, Davidson R, Kasser J. Titanium elastic nails for pediatric femur fractures: a multicenter study of early results with analysis of complications. Journal of Pediatric Orthopaedics. 2001 Jan 1;21(1):4-8.
8. O'Brien T, Weisman DS, Ronchetti P, Piller CP, Maloney M. Flexible titanium nailing for the treatment of the unstable pediatric tibial fracture. Journal of Pediatric Orthopaedics. 2004 Nov 1;24(6):601-9.
9. Ligier JN, Metaizeau JP, Prevot J, Lascombes P. Elastic stable intramedullary pinning of long bone shaft fractures in children. Zeitschrift für Kinderchirurgie. 1985 Aug;40(04):209-12.
10. Yusof NM, Oh CW, Oh JK, Kim JW, Min WK, Park IH, Kim HJ. Percutaneous plating in paediatric tibial fractures. Injury. 2009 Dec 1;40(12):1286-91.
11. Iqbal HJ, Pidikiti P. Treatment of distal tibia metaphyseal fractures; plating versus intramedullary nailing: a systematic review of recent evidence. Foot and Ankle Surgery. 2013 Sep 1;19(3):143-7.
12. Kuhn S, Appelmann P, Mehler D, Pairon P, Rommens PM. Retrograde tibial nailing: a minimally invasive and biomechanically superior alternative to angle-stable plate osteosynthesis in distal tibia fractures. J OrthopSurg Res. 2014 May 13;9:35.
13. Griffet J, Leroux J, Boudjouraf N, Abou-Daher A, El Hayek T. Elastic stable intramedullary nailing of tibial shaft fractures in children. Journal of children's orthopaedics. 2011 Aug;5(4):297-304.
14. Mooney JF, Hennrikus WL. Fractures of the shaft of the tibia and fibula. InRockwood and Wilkins' Fractures in Children: Eighth Edition 2014 Dec 3. Wolters Kluwer Health Adis (ESP).
15. Uludağ A, Tosun HB. Treatment of unstable pediatric tibial shaft fractures with titanium elastic nails. Medicina. 2019 Jun 10;55(6):266.
16. Onta PR, Thapa P, Sapkota K, Ranjeet N, Kishore A, Gupta M. Outcome of diaphyseal fracture of tibia treated with flexible intramedullary nailing in pediatrics age group; A prospective study. Am. J. Public Health. 2015;3:65-8.
17. Jiang LS, Shen L, Dai LY. Intramedullary fixation of subtrochanteric fractures with long proximal femoral nail or long gamma nail: technical notes and preliminary results. ANNALS-ACADEMY OF MEDICINE SINGAPORE. 2007 Oct 1;36(10):821.
18. KC KM, Acharya P, Sigdel A. Titanium Elastic Nailing System (TENS) for Tibia Fractures in Children: Functional Outcomes and Complications. Journal of the Nepal Medical Association. 2016 Oct 1;55(204).
19. Srivastava AK, Mehlman CT, Wall EJ, Do TT. Elastic stable intramedullary nailing of tibial shaft fractures in children. Journal of Pediatric Orthopaedics. 2008 Mar 1;28(2):152-8.
20. Gordon JE, Gregush RV, Schoenecker PL, Dobbs MB, Luhmann SJ. Complications after titanium elastic nailing of pediatric tibial fractures. Journal of Pediatric Orthopaedics. 2007 Jun 1;27(4):442-6.
21. Vallamshetla VR, De Silva U, Bache CE, Gibbons PJ. Flexible intramedullary nails for unstable fractures of the tibia in children: An eight-year experience. The Journal of bone and joint surgery. British volume. 2006 Apr;88(4):536-40.