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Original research article

The clinical, functional and radiological union among the cases of complex proximal and distal tibial fractures, managed by nailing in supra-patellar approach

[1]Dr. Rohith CS, [2]Dr. Megha Naikal, [3]Dr. Manoj Bhagirathi Mallikarjunaswamy, [4]Dr. Pratyush K Sarangi, [5]Dr Viresh

[1]Senior resident, Department of Orthopaedics Chamarajanagar Institute of Medical Sciences, Yadapura, Karnataka, India

[2, 4, 5]Post graduate, Department of Orthopaedics, Chamarajanagar Institute of Medical Sciences, Yadapura, Karnataka, India

[3]Assistant Professor, Department of Orthopaedics, CIMS, Chamarajanagar, Karnataka, India

Corresponding Author:
Dr. **Manoj Bhagirathi Mallikarjunaswamy**

Abstract

Tibial diaphysis is the most common site of fracture in the tibia and about 80% of these injuries are associated with fibular fractures. Surgically, intramedullary nail fixation remains the treatment of choice for displaced and un-displaced tibial shaft fractures in adult population. Supra-patellar nailing in the semi extended position has recently been suggested as a safe and effective surgical technique. All these patients were clinically and radiologically confirmed with proximal and distal tibial fractures, and were eligible for the study. After carrying out necessary laboratory investigations and obtaining physical fitness for surgery, the subjects were surgical managed with expert tibial nailing through suprapatellar approach. The mean VAS, 1 month after surgery was 5.03±1.10, which got significantly reduced to 1.70±0.84 and 0.43±0.50 at 3 and 6 months after surgery. The mean duration required for healing of wounds was 11.87±1.72 days. The radiological union was observed in 90.0% at 6 months and in 100.0% at 12 months, and also the suprapatellar approach was successful in significantly improving the radiological outcome in a short period of time. Delayed union was the only complication observed in 3 individuals. There was statistically significant relation only in terms of age and interval between injury and surgery, thereby suggesting that younger the age of the subjects, earlier the surgery after injury, better was the functional outcome.

Keywords: Proximal and distal tibial fractures, expert tibial nailing, supra-patellar approach, radiological union

Introduction

The most frequent fractures of long bones are those of the tibia and fibula shafts. More than 45 both bone leg fractures occur every year per one lakh people in the average population. Tibial fractures have a wide range of injury mechanisms and degrees of severity connected with them [1, 2].

Adult both bone leg fractures are most common in young guys between the ages of 19 and 39. It frequently affects young individuals and results from high-energy trauma [3]. The most frequent location for tibial diaphysis fractures is the tibia, and roughly 80% of these injuries involve fibular fractures. Tibial fractures have historically had a somewhat high incidence of non-union and poor union [4, 5].

Depending on the soft tissue injuries associated with the tibial shaft fracture, there are many therapeutic options. Poor long-term outcomes and substantial complication rates are linked to severe open tibia fractures. The preferred surgical procedure for treating both displaced and non-displaced tibial shaft fractures in the adult population is intramedullary nail fixation [6, 7].

The standard surgical technique for inserting an intramedullary nail for a tibia fracture is infra-patellar. However, because the quadriceps muscle pulls the proximal fragment into extension, resulting in abnormalities of angulation and fragment displacement, this technique necessitates a flexed knee and makes it challenging to apply appropriately in proximal third tibia shaft fracture [8]. In addition, one of the most common side effects following intramedullary nail implantation is persistent postoperative knee pain [9, 10].

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Thus in 1996, Tornetta and Collins developed a semi-extended nailing technique who employed a medial Para-patellar approach with lateral subluxation of patella and since 2006 the supra-patellar approach for extended knee tibia nailing has gained popularity [11].

Establishing an anatomic starting point appears to be crucial in these fracture patterns, and recent improvements in nail design and reduction techniques have expanded the indications for intramedullary nail fixation to more proximal as well as more distal tibia fractures involving the metaphysio-diaphyseal area.

Recent research suggests that supra-patellar nailing in the semi-extended position is a secure and reliable surgical procedure. By using this technique, an adequate starting point may be established, and the semi-extended position makes it easier to reduce the fracture that causes the apex anterior deformity [12]. Although, many of the previous studies have compared the outcome of this approach in a comparative view with respect to infrapatellar approach, the present study has made an effort to understand the efficiency of the approach on both proximal and distal tibial shaft fractures, in terms of clinical, radiological and functional outcomes.

Methodology

Study Population

Patients with complex proximal and distal fractures of tibia, admitted under the department of Orthopedics of study center during the proposed study period.

Study Design

Prospective clinical study.

Sample Size Calculation

- Total number of complex proximal and distal fractures of tibia operated in the past year = 26.
- Keeping 10% as extra cases = 2.6.
- The estimated sample size of the study was; $26 + 2.6 = 27.6 \approx 28$.
- The total sample size was rounded to 30.

Sampling Method

Convenience Sampling.

Inclusion Criteria

- All skeletally mature patients (Age >18 yrs).
- Proximal and distal metaphyseal fractures of tibia.
- Metaphyseal fractures of tibia extending into diaphysis.
- Type 1 and 2 tibia fractures.

Exclusion Criteria

- Patient age less than 18 years.
- Pathological fractures.
- Type 3 fractures of tibia.
- Non-union and delayed union.
- Patients not fit for surgery.

Patients with clinically and radiologically confirmed proximal and distal metaphyseal fractures of tibia, and were eligible for the study according to the above mentioned eligibility criteria were included in the study after informed consent from the patient.

After carrying out necessary laboratory investigations and obtaining physical fitness for surgery, the subjects were surgical managed with expert tibial nailing through suprapatellar approach.

Patient were followed up post operatively and at 1, 3, 6 and 12 months regularly until the union was achieved both clinically and radiologically.

In all the follow ups, clinical outcome was assessed based on intensity of pain experienced by the subjects using Visual Analogue Scale (VAS). Lysholm Knee Scoring Scale (LKSS) was used to assess the functional outcome. Radiological outcome was assessed based on the grade of callus formation observed radiologically.

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Results

Table 1: Comparison of clinical outcome among the study subjects over the period of follow-up

VAS	Mean	SD	Median	Minimum	Maximum
At 1 month	5.03	1.10	5.00	4.00	7.00
At 3 months	1.70	0.84	1.00	1.00	3.00
At 6 months	0.43	0.50	0.00	0.00	1.00
At 12 months	0.00	0.00	0.00	0.00	0.00

Friedman test
p-value <0.001*
* Statistically significant

In the study, the clinical outcome was assessed by examining the subjective perception of pain experienced by the subjects using Visual Analogue Scale (VAS). Accordingly, the mean VAS, 1 month after surgery was 5.03±1.10, which got gradually reduced to 1.70±0.84 and 0.43±0.50 at 3 and 6 months after surgery. At the end of the follow-up i.e., 12 months after the surgical management, none of the subjects experienced any pain. On analysis, the study found statistically significant difference in the mean and median scores over the period of follow-up, thereby implying that the surgical management was successful in significantly reducing the severity of pain experienced by the subjects in a short period of time.

Table 2: Duration of wound healing among the study subjects

	Mean	SD	Median	Minimum	Maximum
Wound Healing (in days)	11.87	1.72	11.00	10.00	15.00

In the study, the mean duration required for healing of wounds among the subjects was 11.87±1.72 days.

Table 3: Comparison of functional outcome among the study subjects over the period of follow-up

LKSS	Mean	SD	Median	Minimum	Maximum
At 1 month	65.53	3.34	66.00	60.00	70.00
At 3 months	77.07	5.32	76.00	70.00	89.00
At 6 months	92.67	4.61	92.00	85.00	100.00
At 12 months	96.77	2.47	97.00	92.00	100.00

Repeated measures of ANOVA p-value <0.001*
Statistically significant

In the study, the functional outcome was assessed by clinically examining the range of motion and other relevant actions among the subjects using Lysholm Knee Scoring Scale (LKSS). Accordingly, the mean LKSS, 1 month after surgery was 65.53±3.34, which got gradually increased to 77.07±5.32 and 92.67±4.61 at 3 and 6 months after surgery. At the end of the follow-up i.e., 12 months after the surgical management, majority of the subjects showed excellent improvement, with the mean LKSS of 96.77±2.47. On analysis, the study found statistically significant difference in the mean scores over the period of follow-up, thereby implying that the surgical management was successful in significantly improving the functional outcome among the subjects in a short period of time.

Table 4: Comparison of radiological outcome among the study subjects over the period of follow-up

		Frequency (N)	Percentage (%)
RU At 1 month	Grade 0	0	0.0%
	Grade I	30	100.0%
	Grade II	0	0.0%
	Grade III	0	0.0%
RU At 3 months	Grade 0	0	0.0%
	Grade I	4	13.3%
	Grade II	26	86.7%
	Grade III	0	0.0%
RU At 6 months	Grade 0	0	0.0%
	Grade I	0	0.0%
	Grade II	3	10.0%
	Grade III	27	90.0%
RU At 12 months	Grade 0	0	0.0%
	Grade I	0	0.0%
	Grade II	0	0.0%
	Grade III	30	100.0%

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Friedman test
p-value <0.001*
* Statistically significant

In the study, the radiological outcome was assessed by radiologically observing the grade of callus among the subjects. Accordingly, all the subjects showed grade I callus, 1 month after surgery, thereby suggesting the initiation of union within 1 month. The proportion of subjects with better grades of callus got increased gradually, where majority of the subjects were in grade II callus (86.7%) and grade III callus (90.0%), at 3 and 6 months after surgery respectively. At the end of the follow-up i.e., 12 months after the surgical management, all the subjects showed radiological union, with 100.0% grade III callus formation. On analysis, the study found statistically significant difference in the proportions of subjects with different grades of callus formation over the period of follow-up, thereby implying that the surgical management was successful in significantly improving the radiological outcome among the subjects in a short period of time.

Table 5: Distribution of the study subjects based on complications

		Frequency (N)	Percentage (%)
Complications	Yes	3	10.0%
	No	27	90.0%

In the study, majority of the subjects did not develop any sorts of complications (90.0%). Among the remaining subjects who had experienced complications, delayed union was observed in 3 individuals. Other common complications of any orthopaedic procedure such as infection, malunion, non-union, nerve injury and joint stiffness were not observed in the study. This suggests that the surgical management in the study was successful procedure in yielding the outcome with least complications, and 100.0% union rate.

Table 6: Association between the socio-demographics of the study subjects and functional outcome

		LKSS At 12 months			p-value
		Mean	SD	Median	
Age group	<30 years	99.75	0.50	100.00	<0.001*a
	31 to 45 years	97.88	1.26	98.00	
	46 to 60 years	94.13	0.83	94.00	
	>60 years	92.50	0.71	92.50	
Gender	Male	96.90	2.45	97.00	0.649b
	Female	96.44	2.65	96.00	

a-One Way ANOVA b-Independent t-test
*Statistically significant

In the study, the functional outcome at the end of follow-up i.e., 12 months after surgical management was considered for cross-analysis with the relevant parameters. Accordingly, on analysing the association between the socio-demographics such as age and gender of the study subjects with the final outcome, the study found statistically significant relation only in terms of age but not gender, thereby suggesting that gender made no difference in the final outcome among the subjects. Such that, younger the age, better was the functional outcome in the study.

Table 7: Association between the details of injury and functional outcome

		LKSS At 12 months			p-value
		Mean	SD	Median	
Mode of Injury	RTA	96.35	2.66	96.50	0.405a
	Workplace Injury	97.33	1.63	97.50	
	Fall From Height	98.00	2.45	98.50	
Duration till Surgery	<2 days	99.00	0.82	99.00	0.020*a
	3 to 5 days	96.13	1.81	96.00	
	6 to 7 days	95.13	3.00	93.50	
	8 to 14 days	97.60	2.30	97.00	
	>14 days	96.00	1.41	96.00	
Associated Injuries	Yes	96.95	2.63	97.00	0.608b
	No	96.45	2.25	97.00	

a - One Way ANOVA b - Independent t-test
* Statistically significant

Further, on analysing the association between the details of injury such as mode of injury, interval between injury and surgery, and presence of associated injuries with the final outcome, the study found

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statistically significant relation only in terms of duration till surgery, thereby suggesting that mode of injury and presence of associated injuries made no difference in the final outcome among the subjects. Such that, earlier the surgery, better was the functional outcome in the study.

Discussion

The present study found statistically significant difference in the mean and median VAS scores over the period of follow-up, thereby implying that the tibial nailing through suprapatellar approach was successful in significantly reducing the severity of pain experienced by the subjects in a short period of time. This can be substantiated from the findings in the previous studies such as Sun Q *et al.* [13], Chan DS *et al.* [14], Yang L *et al.* [15], McDonald *et al*., and Sanders RW *et al.* [6], which have used to VAS to assess the subjective outcome, and also established significant improvement over the period of follow-up.

In the present study, the functional outcome was assessed by clinically examining the range of motion and other relevant actions among the subjects using Lysholm Knee Scoring Scale (LKSS). Same scale was used in most of the previous studies such as Sun Q *et al.* [13], Chan DS *et al.* [14], Yang L *et al.* [15], and Sanders RW *et al.* [16]. All these studies observed statistically significant difference in the mean LKSS scores over the period of follow-up, thereby implying that the tibial nailing through suprapatellar approach was successful in significantly improving the functional outcome among the subjects in a short period of time.

Also, the present study found statistically significant difference in the proportions of subjects with different grades of callus formation over the period of follow-up, thereby implying that the tibial nailing through suprapatellar approach was successful in significantly improving the radiological outcome among the subjects in a short period of time.

In the present study, delayed union was the only complication observed in 3 individuals, thereby suggesting that tibial nailing through suprapatellar approach yields the outcome with least complications, and 100.0% union rate. Although the union rate was 100.0% in most of the previous studies such as Sun Q *et al.* [13], Yang L *et al.* [15], these studies had found anterior knee pain as the most common complication. Few studies such as Marecek *et al.* [17] and Mitchell *et al.* [18] observed infection as frequent complication.

Overall, on analysis, the present study found statistically significant relation only in terms of age and interval between injury and surgery, thereby suggesting that younger the age of the subjects, earlier the surgery after injury, better was the functional outcome in the study.

Conclusion

- Expert tibial nailing with suprapatellar approach was successful in yielding clinical, functional and radiological union among the subjects with complex proximal and distal tibial fractures in a shorter period of time.
- Delayed union was the only complication associated with the supra-patellar nailing method, which was evident in minimal proportions.

References

1. Aslan A, Uysal E, Özmeriç A. A staged surgical treatment outcome of type 3 open tibial fractures. International Scholarly Research Notices; c2014.
2. Brinker MR, Bailey DE. Fracture healing in tibia fractures with an associated vascular injury. Journal of Trauma and Acute Care Surgery. 1997 Jan 1;42(1):11-19.
3. Howard PW, Makin GS. Lower limb fractures with associated vascular injury. The Journal of Bone and Joint Surgery. British volume. 1990 Jan;72(1):116-120.
4. Puno RM, Teynor JT, Nagano J, Gustilo RB. Critical analysis of results of treatment of 201 tibial shaft fractures. Clinical orthopaedics and related research. 1986 Nov 1(212):113-21.
5. Dujardyn J, Lammens J. Treatment of delayed union or non-union of the tibial shaft with partial fibulectomy and an Ilizarov frame. Acta Orthopædica Belgica. 2007 Oct 1;73(5):630.
6. Zamora R, Wright C, Short A, Seligson D. Comparison between suprapatellar and parapatellar approaches for intramedullary nailing of the tibia. Cadaveric study. Injury. 2016 Oct 1;47(10):2087-90.
7. Wang C, Chen E, Ye C, Pan Z. Suprapatellar versus infrapatellar approach for tibia intramedullary nailing: a meta-analysis. International Journal of Surgery. 2018 Mar 1;51:133-139.
8. Zelle BA, Boni G. Safe surgical technique: intramedullary nail fixation of tibial shaft fractures. Patient safety in surgery. 2015;9:40.
9. Lefaivre KA, Guy P, Chan H, Blachut PA. Long-term follow-up of tibial shaft fractures treated with intramedullary nailing. J Orthop Trauma. 2008;22(8):525-529.
10. Toivanen JA, Vaisto O, Kannus P, Latvala K, Honkonen SE, Jarvinen MJ, *et al.* Anterior knee pain after intramedullary nailing of fractures of the tibial shaft. A prospective, randomized study comparing two different nail-insertion techniques. J Bone Joint Surg. Am. 2002;84-A(4):580-585.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 06, 2024

11. Tornetta P, Collins E. Semiextended position for intramedullary nailing of the proximal tibia. Clinical Orthopaedics and Related Research®. 1996 Jul 1;328:185-189.
12. Zelle BA, Boni G, Hak DJ, Stahel PF. Advances in intramedullary nailing: Suprapatellar nailing of tibial shaft fractures in the semiextended position. Orthopedics. 2015 Dec 1;38(12):751-755.
13. Sun Q, Nie X, Gong J, Wu J, Li R, Ge W, *et al*. The outcome comparison of the suprapatellar approach and infrapatellar approach for tibia intramedullary nailing. International orthopaedics. 2016 Dec;40:2611-2617.
14. Chan DS, Serrano-Riera R, Griffing R, Steverson B, Infante A, Watson D, *et al*. Suprapatellar versus infrapatellar tibial nail insertion: A prospective randomized control pilot study. Journal of orthopaedic trauma. 2016 Mar 1;30(3):130-134.
15. Yang L, Sun Y, Li G. Comparison of suprapatellar and infrapatellar intramedullary nailing for tibial shaft fractures: A systematic review and meta-analysis. Journal of orthopaedic surgery and research. 2018 Dec;13(1):1-3.
16. Sanders RW, DiPasquale TG, Jordan CJ, Arrington JA, Sagi HC. Semiextended intramedullary nailing of the tibia using a suprapatellar approach: radiographic results and clinical outcomes at a minimum of 12 months follow-up. Journal of orthopaedic trauma. 2014 May 1;28(5):245-255.
17. Marecek GS, Nicholson LT, Broghammer FH, Talerico M, Tougas C, Donegan DJ, *et al*. Risk of knee sepsis after treatment of open tibia fractures: a multicenter comparison of suprapatellar and infrapatellar approaches. Journal of Orthopaedic Trauma. 2018 Feb 1;32(2):88-92.
18. Mitchell PM, Weisenthal BM, Collinge CA. No incidence of postoperative knee sepsis with suprapatellar nailing of open tibia fractures. Journal of Orthopaedic Trauma. 2017 Feb 1;31(2):85-89.