



# AN ANALYTICAL STUDY OF POSTOPERATIVE ANTERIOR KNEE PAIN IN TRANSTENDINOUS VERSUS PARATENDINOUS INSERTION TECHNIQUE IN CASE OF INTRAMEDULLARY INTERLOCKING NAILING OF CLOSED TIBIA SHAFT FRACTURE

## Orthopaedics

**Ashoke Kumar Chanda**

M.S. (Orthopaedics), Assistant Professor, deptt. of Orthopaedics, CNMC, Kolkata.

**Arshad Ahmed**

M.S. (Orthopaedics), Assistant Professor, deptt. of Orthopaedics, CNMC, Kolkata

**Debayan Sinha Roy**

M.S. (Orthopaedics), Senior Resident, deptt. of Orthopaedics, CNMC, Kolkata.

**Kallol Banerjee**

M.S. (Orthopaedics), Professor, deptt. of Orthopaedics, CNMC, Kolkata

**Rajiv Roy**

M.S. (Orthopaedics), Professor, deptt. of Orthopaedics, CNMC, Kolkata.

**Rahul Roy\***

M.S. (Orthopaedics), Senior Resident, deptt. of Orthopaedics, CNMC, Kolkata  
\*Corresponding Author

## ABSTRACT

**Objective :** The aim of the study is to compare between paratendinous and transtendinous approaches for tibial intramedullary nailing on post operative anterior knee pain. **Materials and methods:** Total 30 patients of tibia shaft fractures who attended emergency were selected in randomized controlled trial and they were divided in 2 groups 15 patients in each group. In group A transtendinous approach of tibia nailing and in group B paratendinous approach was done. **Results :** The mean followup period was 18 months. Severity of anterior knee pain was assessed by Visual Analogue Scale (VAS). There is no statistical significance between transtendinous and paratendinous approach in different parameters like anterior cortex and nail tip distance, VAS score, Lysholm knee functional score, quadriceps strength for anterior knee pain. **Conclusion:** Tibia nailing being a successful procedure for tibia fracture anterior knee pain remains the main pitfall. In our study we cannot find any approach better for anterior knee pain. Future controlled randomized study with larger population and long term follow-up are required to confirm our result.

## KEYWORDS

Anterior knee pain, Interlocking nail, Paratendinous approach, Tibia shaft fracture, Transtendinous approach.

## INTRODUCTION

Tibial shaft fracture is the most common long bone fracture in the world. Tibia intramedullary nailing is the overall best treatment for closed tibia shaft fractures because of good union rates, better functional outcome, low infection and deformity rates.<sup>1</sup> However chronic anterior knee pain is the most common post operative complication of tibia intramedullary nailing. Its occurrence has been reported from 10-86% of total tibial intramedullary nailing in young and active patients.<sup>2,3</sup> A recent meta-analysis of literature showed incidence of 47.4%.<sup>4</sup> The actual cause of postoperative anterior knee pain is still not known properly and in different studies it is postulated that nail insertion approach, anterior cortex-nail height distance, injury to different anatomical structures like patella tendon, mensci, infrapatellar Hoffa fat pad may be the cause of debilitating anterior knee pain. Different approaches for tibia nailing are transtendinous, medial parapatellar and lateral parapatellar. In this study we compare between transtendinous and paratendinous approach of intramedullary tibia nailing to evaluate post operative anterior knee pain.

## MATERIALS AND METHODS

In this hospital based comparative study total 30 patients with closed tibia shaft fracture were evaluated between November 2018 to April 2020 (18 months). All the patients, who met the inclusion and exclusion criteria were selected by simple random sampling method. Two groups (groups A and B) were divided with 15 in each group. Group A consisted of patients in whom tibia nailing was done through transtendinous approach and in Group B consisted of patients in whom tibia nailing was done through paratendinous. In all patients intramedullary nailing of tibia shaft fracture done with stainless steel tibia nail.

### Inclusion criteria:

1. Closed tibia shaft fracture of any side in both sexes.
2. Patients between 18-60 yrs of age.
3. With associated fibula fracture of same side.

### Exclusion criteria:

1. open fracture
2. Associated neurovascular deficit
3. Associated femur fracture of same side
4. Segmental tibia shaft fracture
5. Associated ligament injury of ipsilateral knee
6. Grade III, IV soft tissue injury.

All the patients were informed about the modes of treatment and written informed consent taken from the patients in their own mother language after reading and understanding the consent form. Prior approval from ethics committee of Calcutta national medical college was obtained for this study.

## RESULTS

This study was conducted for a time period of 18 months, from November 2018 to April 2020, with 30 patients of closed shaft fractures of Tibia as subject and grouping them into two groups of 15 patients each, Group A and Group B. Group A consisted of patients in whom tibia nailing was done through transtendinous approach and in Group B consisted of patients in whom tibia nailing was done through paratendinous.

Following is the summary of the results obtained from the study. Most common age group was 21-30 years (43.3%) in both groups. Males were most commonly affected (73.30%). Male: female = 2.75:1 in both groups. Significant increase of range of motion seen in both groups from 2<sup>nd</sup> week to 6<sup>th</sup> week of follow-up. Total 15 (50%) patients had anterior knee pain in 6<sup>th</sup> week visit. 8 (53.3%) patients of group A and 7 (46.7%) of group B had anterior knee pain at 6<sup>th</sup> week of visit. There was significant decrease of VAS score for knee pain in both Group A and Group B between 6<sup>th</sup> week and 12<sup>th</sup> week visit.<sup>table1</sup> There was no significant difference of functional outcome of knee between the 2 groups due to anterior knee pain at 12<sup>th</sup> week of post surgery by evaluating Lysholm knee score. In most of the patients of both groups radiological union occurred within 20 weeks (86.7% in group A and 73.3% in group B). Only 1 patient of group B required dynamisation and 1 patient of Group B had infection at incision site (which was managed by debridement, copious lavage and antibiotic treatment). No occurrence of significant difference of quadriceps weakness was noted between two groups at 6<sup>th</sup> week post-operative follow-up. No significant difference in mid thigh wasting was noted between 2 groups at 6 months of follow-up. Increased incidence of anterior knee pain at 6<sup>th</sup> week follow-up was noted in both the groups amongst them who had anterior nail tip protrusion (ACN) >5mm compared to them who had ACN <5mm, but there was no significant difference among the groups.<sup>table2,3</sup> BMI is related to anterior knee pain in our study as in group B it was significant as p value <0.05.

**Table 1. Severity of anterior knee pain according to VAS score in two groups**

VAS score	6 weeks	12 weeks	P value
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Group A	Sample size	15	15	0.038
	Mean $\pm$ SD	3.47 $\pm$ 3.54	2.47 $\pm$ 2.48	
Group B	Sample size	15	15	0.012
	Mean $\pm$ SD	2.47 $\pm$ 3.02	1.80 $\pm$ 2.34	
Comparison of means of two groups	P value	0.378	0.499	

**Table 2: Comparison between anterior cortex nail distance and knee pain after Surgery among group A (n=15).**

Knee pain		Anterior cortex nail distance			Total	P value
		<0 mm	0-5 mm	>5 mm		
6 weeks after OT	Yes	1 (20.0%)	3 (60.0%)	4 (80.0%)	8 (56.7%)	0.153
	No	4 (80.0%)	2 (40.0%)	1 (20.0%)	7 (43.3%)	
6 months after OT	Yes	1 (20.0%)	1 (20.0%)	3 (60.0%)	5 (33.3%)	0.301
	No	4 (80.0%)	4 (80.0%)	2 (40.0%)	10 (66.7%)	
Total		5 (33.3%)	5 (33.3%)	5 (33.3%)	15 (100.0%)	

**Table 3: Comparison between anterior cortex nail distance and knee pain after Surgery among group B (n=15).**

Knee pain		Anterior cortex nail distance			Total	P value
		<0 mm	0-5 mm	>5 mm		
6 weeks after OT	Yes	1 (50.0%)	2 (33.3%)	4 (57.1%)	7 (43.3%)	0.689
	No	1 (50.0%)	4 (66.7%)	3 (42.9%)	8 (56.7%)	
6 months after OT	Yes	1 (50.0%)	2 (33.3%)	1 (14.3%)	4 (26.7%)	0.537
	No	1 (50.0%)	4 (66.7%)	6 (85.7%)	11 (73.3%)	
Total		2 (13.3%)	6 (40.0%)	7 (46.7%)	15 (100.0%)	

**Table 4: Comparison between ROM knee at subsequent visit among both groups (n=30)**

ROM knee (in degree)		2 weeks	6 weeks	P value
Group A	Sample size	15	15	<0.001
	Mean $\pm$ SD	101.67 $\pm$ 12.77	126.67 $\pm$ 11.75	
Group B	Sample size	15	15	<0.001
	Mean $\pm$ SD	100.0 $\pm$ 12.54	123.33 $\pm$ 9.76	

**Table 5: comparison between BMI and knee pain after Surgery among group A (n=15).**

Knee pain		Anterior cortex nail distance				Total	P value
		Under weight	normal	Over Weight	Obese		
6 weeks after OT	Yes	1 (100.0%)	3 (33.3%)	3 (75.0%)	1 (100.0%)	8 (56.7%)	0.267
	No	0 (0.0%)	6 (66.7%)	1 (25.0%)	0 (0.0%)	7 (43.3%)	
6 months after OT	Yes	1 (100.0%)	2 (22.2%)	2 (50.0%)	0 (0.0%)	5 (33.3%)	0.321
	No	0 (0.0%)	7 (77.8%)	2 (50.0%)	1 (100.0%)	10 (66.7%)	
Total		1 (6.7%)	9 (60.0%)	4 (26.7%)	1 (6.7%)	15 (100.0%)	

**Table 6: comparison between BMI and knee pain after Surgery among group B (n=15).**

Knee pain		Anterior cortex nail distance				Total	P value
		Under weight	normal	Over Weight	Obese		
6 weeks after OT	Yes	1 (100.0%)	1 (12.5%)	4 (80.0%)	1 (100.0%)	7 (43.3%)	0.041
	No	0 (0.0%)	7 (87.5%)	1 (20.0%)	0 (0.0%)	8 (56.7%)	
6 months after OT	Yes	1 (100.0%)	0 (0.0%)	2 (40.0%)	1 (100.0%)	4 (26.7%)	0.031
	No	0 (0.0%)	8 (100.0%)	3 (60.0%)	0 (0.0%)	11 (73.3%)	
Total		1 (6.7%)	8 (53.3%)	5 (33.3%)	1 (6.7%)	15 (100.0%)	

## DISCUSSION

Tibial shaft fractures are most common long bone fracture around the world. But the postoperative anterior knee pain complication seen at frequencies upto 50% after intramedullary nailing was a challenging issue. The cause of anterior knee pain after tibia intramedullary nailing are thought to be multifactorial. This may be due to entry point of the nail, heterotrophic ossification, height of the nail, trauma to

infrapatellar branch of the Saphenous nerve, traumatisation of patella tendon or infrapatellar fat pad, postoperative muscle weakness, malalignment and age.

In our study, majority of the patients were in the age group of 21-30years. Court-Brown et al<sup>5</sup> and Keating et al.<sup>6</sup> identified that younger patients have greater risk for chronic anterior knee pain probably as they are more active than older patients.

Incidence of anterior knee pain in this study is 50%. In group A it is 53.3% and in group B incidence was 46.7%. Katsoulis et al.<sup>3</sup> reported the incidence of anterior knee pain as 47%. Court-Brown et al<sup>5</sup> showed an incidence of anterior knee pain as 56.2% Orfaly et al. compared the paratendinous and transtendinous surgical approaches in the postoperative anterior knee pain. Their study reported that the transtendinous approach caused the complication of postoperative knee pain. A prospective study conducted by Keating et al reported that the AKP complication was multifactorial. They stated that the transtendinous approach was among the major reasons for this complication.

In our study there was no significant difference among the groups regarding knee pain at 6<sup>th</sup> week (p>0.05).

In our study it was seen that both groups, transtendinous (Group-A) and paratendinous (Group B) had statistically significant improvement in knee ROM in subsequent visits.<sup>table4</sup> The VAS score of anterior knee pain also decreases at a significant value in both groups in subsequent visits. So proper rehabilitation program can decrease the incidence of anterior knee pain.

The protrusion of nail tip (anterior and superior prominence) has been reported as one of the contributing factors for knee pain. Keating et al<sup>7</sup> in their study had observed that anterior knee pain was more related to ACD (of more than 5mm) rather than the height of nail. However, Bhattacharyya et al<sup>8</sup> reported that both anterior and superior nail prominence caused pain. In their study the greater incidence of rest pain was seen in anterior nail prominence, whereas superior nail prominence was associated with pain while kneeling.

Our study showed that at 6wk follow-up in both groups those who had anterior cortex nail (ACN) >5mm length, had a higher incidence of anterior knee pain than who had ACN <5mm. At 6month of follow-up group A (Transtendinous) those who had ACN>5mm had a higher occurrence of anterior knee pain than who had ACN<5mm. In group B ACN>5mm had less anterior knee pain than who had ACN<0.5 there was no significant difference between the groups as p value>0.5.

Väistö et al.<sup>9</sup> followed up 40 patients for the postoperative functional outcomes and muscle strengths after intramedullary nail of tibia. The study reported the etiology of the anterior knee pain to be multifactorial. It was reported that the pain originated from the loss of muscle strength in the flexor muscles of the knee rather than that in the extensors. However in our study there was no significant difference among the groups regarding post operative Quadriceps weakness and post operative mid-thigh wasting at 6months follow-up.

When we compare functional outcome post operatively at 12 week, Group A (transtendinous approach) showed 5 (33.5%) with poor outcome, 4 fair, 3 good and 3 excellent on the basis of Lysholm Score and in Group B (paratendinous approach) 1 (6.6%) with poor outcome, 6 with fair, 4 good, 4 excellent. There was no significant difference between 2 groups regarding operative outcome (p>0.05).

While comparing VAS score among Group A and Group B in 6 week and 12 week visit we did not find any significant difference in VAS score (p>0.05) in both visits but mean VAS score was less in paratendinous approach (Group B) in both visits.

In group A after surgery occurrence of knee pain was less in patient with Normal BMI than the others (underweight, overweight and obese). There was no statistically significant difference between the groups (p value > 0.05).<sup>table5</sup>

In group B (Paratendinous group) 6 weeks after surgery occurrence of knee pain is less in patient with normal BMI than the others (underweight, overweight and obese). There was statistically significant difference between the groups (p value < 0.05). At 6 months

follow-up post surgery, occurrence of knee pain is less in patients with normal BMI than the others (underweight, overweight and obese). There was statistically significant difference between the groups (p value <0.05).<sup>table5</sup>

Usually the pain begins some days to month after surgery. The cause of this postoperative knee pain is unknown. In a study after removal of the nail complete resolution of symptoms in 27.4% of patients with marked improvement in 69.3% was seen.<sup>10</sup> However in our study we did not remove nail of any patients. Devitt et al<sup>11</sup> found arthroscopic evidence of chondromalacia patellae in a small number of patients with anterior knee pain after tibia nailing. They described an increase in force and contact pressure on the lateral facet when the medial paratendon approach was used and on the medial facet with a transtendinous approach. Pressure increases were more notable with the latter and patellar chondral injury was more likely.

Some studies showed that transtendinous approach was associated with high rates of anterior knee pain and recommended paratendinous approach for nail insertion. But in contrast to this theory in a retrospective study by Keating et al<sup>12</sup> reported that medial parapatellar approach had 50% incidence of anterior knee pain. In a prospective study by Vaisto et al. noted that 75% incidence of knee pain with medial parapatellar approach. Some authors reported that there is no association of anterior knee pain with surgical approach<sup>9,13</sup>. In our study, comparing some most common etiologic factors in the literature in relation to anterior knee pain development after tibia intramedullary nailing we found that anterior nail tip protrusion >5mm, patients with increased BMI had a positive relation with anterior knee pain. But there is no statistical difference between the two groups. So anterior knee pain after tibia nailing may not be associated with the approaches of tibia nailing. Rather postoperative rehabilitation programs and proper position of nail must be looked for. A healthy post operative diet also be encouraged for the patients with increased BMI.

In a meta analysis of 11 retrospective and 9 prospective studies, a total of 1469 fractures showed there was no statistical difference between the approaches for anterior knee pain. Among the 1460 patients, 629 had symptoms of anterior knee pain independent of the approach used<sup>12</sup>. My study result also supports reviewer's result.

Leliveld and Verhofstd studied with 136 tibia fractures came to a hypothesis that iatrogenic injury to the infrapatellar branch of saphenous nerve is an important cause for anterior knee pain<sup>13</sup>. In medial paratendinous approach if skin incision is taken medially, the infrapatellar branch of the saphenous nerve can be preserved.

So from my study result between the two approaches of tibia nailing I can not appreciate any one to be better to overcome the postoperative knee pain. Both the approaches did not show any significant difference of post operative anterior knee pain and functional outcome. Improvement of the anterior knee pain also did not show any significant difference.

## CONCLUSION

Tibia intramedullary nailing is a very successful procedure for tibial diaphysis fracture but anterior knee pain is the main postoperative complication of it. Our study also shows incidence of 50%. Between the two exposures (transtendinous and paratendinous) of tibia nailing my study shows no difference for anterior knee pain. Regular post operative static and dynamic quadriceps and hamstring exercises can reduce the chance of anterior knee pain. Overweight and obesity may be a cause of knee pain. So a healthy diet may also be helpful in postoperative period. But the groups are relatively small and study period is less to accept this null hypothesis with full confidence. Future controlled randomized studies with larger population and long term followup are required to confirm my results.

## Declarations

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Conflict of interest: there is no conflict of interest

Ethical approval: ethical approval given by ethics committee of Calcutta national medical college and hospital

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