A CASE CONTROL STUDY FOR PREVALENCE AND SEVERITY OF ANTERIOR KNEE PAIN POST TIBIAL INTERLOCKING NAIL INSERTION

Abstract:
Intramedullary nailing of the tibia as a treatment of diaphyseal tibia fractures has been shown to produce excellent results with low rates of non union, mal union, joint stiffness, and infection when compared to alternative treatment. The prevalence of anterior knee pain following intramedullary tibial nail insertion has been reported as been between 10% to 86%. However, a recent meta-analysis of the literature estimated the incidence at 47.4%. Several studies have aimed to identify technical causes for the pain but there have been no comparisons made to the background population. The previous work has made no reference to or investigated any pre-existing anterior knee pain in these patients.

We hypothesized that the prevalence of anterior knee pain post tibial nailing is at the lower end of the published figures and is of low severity. We also hypothesized that pre-existing anterior knee pain is a significant contributory factor for the post tibial nailing anterior knee pain.

Aims And Objectives: To compare the prevalence of anterior knee pain in the operated knee with the contralateral healthy knee using a VAS Score and to study functional impairment using a Functional Anterior Knee Pain Score of International Knee Society (Insall Modification - 1993).

Material And Methods: Type of Study – Prospective cross-sectional


Minimum Sample Size- 50 patients.

Study Methodology: All patients who had a tibial nail inserted at our institution (M.G.M Medical College and M.Y hospital, Indore) from June 2012 to July 2016. All patients in their follow up visit will be asked questions and questionnaire will be filled by the investigator relating to symptoms experienced in the knee of the injured limb and the knee of the contralateral normal side. The questionnaire included demographic data, occupation, Functional Anterior Knee Pain Score of Knee society (Insall Modification - 1993) maximum Knee and functional Score is 100 points, analogue pain score (0-10). The analogue scale used to divide patients into categories of mild or no pain (0-3), moderate pain (4-7), and severe pain (8-10). Statistical Analysis will be carried out using the Unpaired t-test.

Discussion: Comparison of vas score between the operated knee and contra lateral knee was done and unpaired “t” test was applied which was not
statistically significant showing that mean pain score in both the knees was comparable which means that anterior knee pain is not necessarily associated with the tibial inter locking nail insertion. Whereas, in the previous study done by Cartwright-Terry et al studied that relative risk of anterior knee pain following tibial nailing is twofold compared to the contra lateral knee and to a comparative control population. The severity of any anterior knee pain in the uninjured limb is likely to correlate with post tibial nailing anterior knee pain.

Insall results in relation to laterality of the operated knee were discussed which shows that 2.7% of the total population had poor results, 1.4% of the total population had fair results and 95.9% of the total population had excellent results and no association was found with the insall results and laterality of the operated knee.

Comparison of vas score in relation to insall relation were done which showed that vas score in poor outcome was 9.0 in fair outcome it was 8.0 and an excellent outcome it was 2.01 which was statistically significant showing that vas score was highest in poor outcome and lowest in excellent outcome. One way anova test was applied which was statistically significant.

**Introduction**

Tibia is the most commonly fractured long bone in the body with an annual incidence of tibial shaft fractures is 2 per 1000 individuals. Since the tibia is the large bone of the body and one of the principal load bearing bones in lower extremity, fractures can cause prolonged morbidity, extensive disability unless treatment is appropriate. Various techniques are now available for treatment of diaphyseal fractures of tibia where orthopaedic surgeon must be aware of the advantages, disadvantages and limitation of each to select the proper treatment for each patient. The type, location, degree of comminution, age, patients social and economic demands may influence the method of treatment. The use of non-operative treatment of tibial fractures that are widely displaced or that are the result of high-energy forces is associated with a high prevalence of malunion, stiffness of the joint, and poor functional outcome.

As a result of ability to lock the nail proximally and distally, closed intramedullary nailing became GOLD STANDARD treatment for closed shaft fractures. Good results had been shown by using locking nails for both closed and Gustilo grade I open fractures (Gustilo and Anderson, 1976; Kfemm and Broner, 1986; Court–Brown et al., 1990; Hooper et al., 1991).

### Advantages associated with Tibia Interlocking nail are:

1. Immediate mobilization.
2. Minimal blood loss during procedure as it is a close reduction.
3. Hospitalization & Convalescence are short.
4. Less chances of infection
5. Low rates of morbidity and mortality.

Although it is associated with some disadvantage as well: Anterior Knee Pain which has been attributed to different factors by different authors:

1. Approach used
2. Nail Protrusion
3. Technique used
4. Instruments used
5. Reaming

The prevalence of anterior knee pain following intramedullary tibial nail insertion has been reported as been between 10% to 86%. However, a recent meta-analysis of the literature estimated the incidence at 47.4%. Several studies have aimed to identify technical causes for the pain but there have been no comparisons made to the background population. Of those studies, only a few have tried to quantify the severity of symptoms, determine the functional impairment suffered by the patients, or analysed which activities were problematic. The previous work has made no reference to or investigated any preexisting anterior knee pain in these patients.

As incidence of this Anterior Knee Pain has not been evaluated in reference to the pre-existing Anterior Knee Pain prevalence in background population, we conducted this study to understand whether Anterior Knee Pain is due To Tibia Interlocking Nail or is it just the aggravation of pre-existing Anterior Knee Pain post Tibial Interlocking Nail Insertion?
Aims & Objectives

Primary Aim

To compare the prevalence of anterior knee pain in the operated knee with the contralateral healthy knee using a VAS Score post-tibial nailing

Secondary Aim

1. To assess the functional impairment in the operated knee using a Functional Anterior Knee Pain Score of Knee Score Society (Insall Modification - 1993).
2. To determine if there was a correlation between pre-existing anterior knee pain symptoms and post nailing anterior knee pain symptoms.

Material And Methods

This is a prospective cross-sectional study conducted in Department of Orthopaedics M.G.M Medical College and M.Y hospital, Indore. This will include patients of both sex and age group between 18-50 year, admitted in the orthopaedic wards with diaphyseal fracture of tibia. All cases will be followed for a period of 6 months with:

- Study Duration – June 2012 to January 2017
- Minimum sample size of -50 patients.

All patients who were 18 years and older with close fracture of the tibia diaphysis with following inclusion and exclusion criteria:

Inclusion Criteria

1. Patients who had undergone unilateral intramedullary tibial interlocking nail insertion for diaphyseal fracture of tibia from June 2012 to July 2016 done in Department of Orthopaedics M.G.M Medical College and M.Y hospital, Indore.
2. All cases included in study are at least 6 month post-operative with good fracture union.

Exclusion Criteria

1. Bilateral tibia fractures
2. Compound Fractures
3. Any old bony injury to the same lower limb.
4. Any previous history of long bone fracture to the non-affected limb.
5. Any post-operative complication which has unduly prolonged his treatment time.
6. Pathological fractures
7. Polytrauma patients with expected delay in primary and immediate fixation.
8. Uncontrolled diabetes, morbid obesity with BMI > 40, immuno compromised patients, patients on chronic steroid therapy and debilitated patients.

Case Selection

All patients of or above 18 years of age, of either sex having close fracture of the diaphysis of the tibia were chosen for the dynamic interlocking nailing. Patients selected were fit for suitable anesthesia preferably spinal anesthesia i.e. had no major head, chest or abdomen injury.

The management of the injury was based on the following protocol.

Initial Management and Resuscitation:

1. The patient was received in the emergency and his vital parameters were recorded & monitored.
2. Associated limb, chest, abdomen and head injury were ruled out.
3. An intravenous line was established, tetanus prophylaxis and I/V cephalosporin antibiotics was given, fluid replacement started and hemorrhage from the wound was controlled by pressure bandage.
4. A groin to toes slab was applied by simply aligning the bone. Other wounds, if any, were taken care of appropriately.
5. The patient once settled from the acute injury, was shifted to the orthopaedic ward.

Description Of IL-Nail

A specially constructed IL-nail was used for the purpose in all cases. IL-nail is a hallow, metallic modified clover-leaf nail having a D-shaped platform at its proximal end (head) and a proximal locking hole. It has proximal bent of 20° in anteroposterior direction to compensate for the proximal Herzog’s curve within the medullary canal. The nail has a slot along its whole length on the posterior direction which facilitates unreamed nail insertion (A.O.-UTN-Melcher et al, 1993). About 2.5cm above the tip of the nail is a distal locking hold in the anteroposterior direction.

A suitable length of the nail is chosen by measuring from the tibial tuberosity to the base of the medial malleolus on the unaffected side. The diameter of the nail is decided according to the size of medullary canal on the X-ray or by reaming.

Operative Procedure

All cases were operated as soon as possible with proper pre-operative workup. All cases were done in the orthopaedic operation theatre. Close intramedullary nailing was done without opening the fracture site and with or without reaming. All patients
were operated with midline incision and transpatellar approach.


1. In the operation theatre, under anesthesia,
2. Under all aseptic precaution, painting and draping done.
3. Then a tourniquet is applied and a pad is placed under the proximal part of the thigh.
4. A 3” long incision is marked on the anterior aspect of the tibial tuberosity.
5. The patellar tendon is incised along the skin incision.

iii. The IL nail is introduced over guide wire with its eye anteriorly and the slot kept posteriorly. The fracture is close reduced under IITV and the nail is negotiated into the distal fragment with the gentle taps of the hammer over the nail head, keeping the nail dead parallel to the axis of the limb. Impaction may be done, if needed, by padded gentle strokes over the heel.

iv. The distal locking of the nail is done as under IITV using the free hand technique. An appropriate length of 4.5 mm cortical screw is used for locking.

v. Compression bandage is applied and the tourniquet is removed and GT slab applied.

vi. Cephalosporin antibiotics are continued.

**Postoperative Regimen**

The limb is kept elevated at all times and active toe movements are encouraged. The patient is watched for excessive swelling, pain and distal circulation. The first dressing is done after 2 days of the operation. Active knee and ankle mobilization is started immediately after the dressing and kept non-weight bearing for 3 weeks. If suture line is clean, suture removal done after 10 to 12 days under full asepsis. The compression bandage is removed a crepe bandage is applied from knee to the ankle. Partial weight bearing with 2 axillary crutches started after 3 weeks. Gait training on the parallel bars if possible, can also be done. Review after 3 weeks, 6 weeks, 3 months and 6 months. Advice regarding full weight-bearing is given on the basis of pain and the stability of the fracture fixation.

**Follow-Up And Evaluation**

The patient is usually followed up at 6 months. Check X-rays are taken at the visit and patient is assessed clinically for fracture union. The results are assessed on the basis of VAS Score and Insall Knee Score.

**VAS Score has 3 criteria:**

1. Mild (0-3)
2. Moderate (4-7)
3. Severe (8-10)

The functional assessment of the results is on the basis of Insall Knee Score (Insall Modification 1993)

a. Pain
b. Range of Motion
c. Stability
d. Extension Lag and Flexion Contractures and Malalignment
e. Pain at rest
Table No. 1
Distribution of patients according to age (N=73)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 20 years</td>
<td>6</td>
<td>8.2</td>
</tr>
<tr>
<td>21-30 years</td>
<td>34</td>
<td>46.6</td>
</tr>
<tr>
<td>31-40 years</td>
<td>23</td>
<td>31.5</td>
</tr>
<tr>
<td>41-50 years</td>
<td>10</td>
<td>13.7</td>
</tr>
<tr>
<td>Total</td>
<td>73</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table shows the distribution of patients according to age. There were 6 (8.2%) patients in the age group < 20 years, 34 (46.6%) in the age group 21-30 years, 23 (31.5%) in the age group 31-40 years and 10 (13.7%) in the age group 41-50 years. Majority of the patients were in the age group 21-40 years.

Graph No. 1: Pie diagram showing the distribution according to age

Table No. 2
Distribution of patients according to gender (N=73)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>7</td>
<td>9.6</td>
</tr>
<tr>
<td>Male</td>
<td>66</td>
<td>90.4</td>
</tr>
<tr>
<td>Total</td>
<td>73</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table shows the distribution of patients according to gender. There were 7 (9.6%) females and 66 (90.4%) males in the present study. There was a male preponderance in relation to the females.

Graph No. 2: Pie diagram showing the distribution according to gender

Table No. 3
Distribution of patients according to laterality (N=73)

<table>
<thead>
<tr>
<th>Laterality</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>41</td>
<td>56.1</td>
</tr>
<tr>
<td>Right</td>
<td>32</td>
<td>43.9</td>
</tr>
<tr>
<td>Total</td>
<td>73</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table shows the distribution of patients according to laterality. There were 41 (56.1%) patients in whom left side was operated and in 32 (43.9%) patients right side knee was operated. In majority of the patients left knee was operated in comparison to the right knee.

Graph No. 3: Pie diagram showing the distribution according to laterality

Table No. 4
Distribution of patients according to mode of injury (N=73)

<table>
<thead>
<tr>
<th>Mode of Injury</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assault</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Fall</td>
<td>4</td>
<td>5.5</td>
</tr>
<tr>
<td>RTA</td>
<td>68</td>
<td>93.2</td>
</tr>
<tr>
<td>Total</td>
<td>73</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table shows the distribution of patients according to mode of injury. In 1 (1.4%) patient assault was the mode of injury, in 4 (5.5%) patients it was fall and in majority 68 (93.2%) patients mode of injury was RTA.

Graph No. 4: Pie diagram showing the distribution according to mode of injury

Table No. 5
Comparison of VAS Score between the Operated and Contralateral Knee (N=146)

<table>
<thead>
<tr>
<th>VAS Score</th>
<th>Operated Knee</th>
<th>Contralateral Knee</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>None (0)</td>
<td>40</td>
<td>54.8</td>
</tr>
<tr>
<td>Mild Pain (1-3)</td>
<td>25</td>
<td>34.2</td>
</tr>
<tr>
<td>Moderate Pain (4-7)</td>
<td>5</td>
<td>6.8</td>
</tr>
<tr>
<td>Severe Pain (8-10)</td>
<td>3</td>
<td>4.1</td>
</tr>
<tr>
<td>Total</td>
<td>73</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Mean ± SD (Score) 1.49 ± 2.15, 1.10 ± 1.86
`t` Value 1.195, df=144
P Value 0.2339, NS

Unpaired `t` test applied. P value = 0.2339, Not significant

The above table shows the distribution of patients according to VAS pain score in both operated and contralateral knee. In the operated knee, 40 (54.8%) of the patients had VAS score 0, 25 (34.2%) patients had mild pain, 5 (6.8%) patients had moderate pain and 3 (4.1%) patients had severe pain. In the contralateral knee, 43 (58.9%) of the patients had VAS score 0, 24 (32.9%) patients had mild pain, 3 (4.1%) patients had moderate pain and 3 (4.1%) patients had severe pain. The mean VAS score in operated knee was 1.49 ± 2.15 and in the
contralateral knee it was $1.10 \pm 1.86$. The difference was found to be statistically not significant ($P>0.05$), showing that mean pain score in both the legs was comparable.

Anterior knee pain was present in 33 and absent in 40. Of the 33 knees in which anterior knee pain was present, contralateral knee pain was present in 30 and was absent in 3, while in all the 40 patients in whom the anterior knee pain was absent, it was absent too in contralateral knee.

Thus, we can say that interlocking could be aggravating factors for existing workout on anterior knee pain but is not the independent cause of anterior knee pain.

Discussion

Anterior knee pain is probably the commonest musculoskeletal problem in general practice. There are various causes of anterior knee pain are:

- Patellofemoral Pain Syndrome,
- Trauma - Dislocation, Osteoarthrosis,
- Cartilage Abnormalities, Osteochondritis Dissecans, Bipartite Patella- Dorsal defect of the patella,
- Synovial plica, Extensor mechanism tears, Bursitis, Osgood Schlatter Disease and Excessive lateral pressure syndrome.

Various studies have been conducted to understand the cause of anterior knee pain post tibial interlocking nail insertion which came out to be multifactorial.

It may be either due to the approach used in nail insertion, nail protrusion or the method of the operation.

So, we conducted this study to understand the various aspects of anterior knee pain after tibia interlocking nail insertion.

Prevalence of anterior knee pain in nailed limb in our study was 45%. According to the study done by Cartwright et al, had reported a prevalence of 83% and Court Brown et al reported it to be 91.8%. In our study the prevalence was lowest in

The mean VAS score in poor outcome was $9.00 \pm 0.00$, in fair outcome it was $8.00$ and in excellent outcome it was $2.01 \pm 1.12$. Comparison of means between the groups, showed that there is a statistically significant difference ($P<0.05$). The mean VAS score was highest in poor outcome and lowest in excellent outcome.

Though the ANOVA was statistically significant, we could not apply post-hoc Tukey as fair outcome was having only 1 patient and because of this standard deviation cannot be calculated.
Comparison to the other studies.

Distribution of patients according to age, in which there are total of 73 patients, 8.2% were below age of 20 years, 46.6% in age group of 21-30 years, 31.5% in the age group of 31-40 years, 13.7% in the age group of 41-50 years. Having the majority of the patients in the age group of 21-40 years. With an average age of 30.97 years. Whereas, in the previous study taken up by Cartwright-Terry et al. They have an average age of 39.4 years. We have a younger age group in our study.

Distribution of patients according to gender has been done which showed that out of total population 9.6% were females and 90.4% of the total populations were males.

Distribution of patients according to laterality was done which showed that 56.1% patients of the total population were operated on the left side, whereas 43.9% of the total population was operated on the right side.

Distribution of patients according to the mode of injury has been done which shows 1.4% of the total population were the cases of assault, 5.5% of the total population were the cases of fall and rest 93.2% were the cases of road traffic accidents.

Comparison of vas score between the operated knee and contra lateral knee was done and unpaired “t” test was applied which was not statistically significant showing that mean pain score in both the knees was comparable which means that anterior knee pain is not necessarily associated with the tibial inter locking nail insertion. Whereas, in the previous study done by Cartwright-Terry et al. studied that relative risk of anterior knee pain following tibial nailing is twofold compared to the contra lateral knee and to a comparative control population. The severity of any anterior knee pain in the uninjured limb is likely to correlate with post tibial nailing anterior knee pain.

Insall results in relation to laterality of the operated knee were discussed which shows that 2.7% of the total population had poor results, 1.4% of the total population had fair results and 95.9% of the total population had excellent results and no association was found with the insall results and laterality of the operated knee.

Comparison of vas score in relation to insall relation were done which showed that vas score in poor outcome was 9.0 in fair outcome it was 8.0 and an excellent outcome it was 2.01 which was statistically significant showing that vas score was highest in poor outcome and lowest in excellent outcome. One way anova test was applied which was statistically significant.

Of the 33 knees in which anterior knee pain was present, contralateral knee pain was present in 30 and was absent in 3, while in all the 40 patients in whom the anterior knee pain was absent, it was absent too in contralateral knee.

Conclusion

Tibial interlocking nail has been the goal standard treatment for closed shaft tibia fracture. There has been various techniques of tibial interlocking nail insertion, approach and instrumentation. Several studies had aimed to identify the technical cause for the anterior knee pain but there has been no comparison made to be the background population. The previous work has made no reference to or investigated any pre-existing anterior knee pain in these patients. The prevalence of anterior knee pain following intra-medullary tibial nail insertion has been reported between 10% to 86%. However, a meta analysis of the literature estimated the incidence at 47.4%. This study was undertaken to compare the prevalence of anterior knee pain in the operated knee with the control population. We found that interlocking could be aggravating factors for existing workout on anterior knee pain but is not the independent cause of anterior knee pain. The difference in p value of mean vas score was not statistically significant, showing mean pain score in both the knee was comparable. We conclude here that tibia interlocking nail insertion is not necessarily associated with the anterior knee pain, however, it may be responsible for the occurrence or increase in severity of anterior knee pain which may be already present in the knee when compared to the contra lateral knee which was taken as our control.

References

4. Th Karachalios, G Babis, J Tsarouchas, G Sapkas, Th Pantazopoulos The clinical performance of a small diameter tibial nailing system with a mechanical distal aiming device. Volume 31, Issue 6, Pages 451-459


