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A study of anterior knee pain after intramedullary interlocking nails used for tibial shaft fractures treatment

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Abstract
Background: Tibial shaft fractures remain the more common of all fractures and routinely treated with intramedullary interlocking nail. One of the most common complication is anterior knee pain after intramedullary nailing of tibia fractures. The exact etiology of anterior knee pain after tibia nailing is still debatable and unknown.
Methods: We evaluated 48 patients treated for tibia shaft fractures with intramedullary interlocking nail at our institute from the period between January 2016- December 2020. All patients were treated with transtendinous approach by single surgeon. Patients were assessed at follow up and incidences of knee pain were noted. Serial x ray and clinical evaluation were done with VAS score at final follow up. Final clinical outcome evaluated with modified lysholm score.
Results: In our study incidence of knee pain remained 33% in overall patients. As per Modified lysholm score 62% patients with excellent outcome followed by 23% good and 15% fair outcome respectively.
Conclusion: Proper surgical techniques and correct placement and sizing may alleviate the incidences of anterior knee pain after tibia nailing.

Keywords: tibia nail, anterior knee pain, trans patellar approach, transtendinous approach

Introduction
Tibial shaft fractures remain the more common of all fractures in terms of fracture incidence. In the recent era of developing country where younger population using commuting mode leads to rise in the incidence of tibial shaft fracture gradually due to road traffic accidents, nonetheless the other modes of trauma seconds the table after RTA. The gold standard treatment in current era for tibial shaft fracture is intramedullary interlocking nail [1, 2] The treatment with interlocking nail in displaced fractures allows early weight bearing , early rehabilitation, avoids cast related complications.
Usually interlocking nail used by two approaches (i) patellar split approach (ii) medial paratendinous approach. There is available supported literature to use reamed and un-reamed nail in specific indications on case by case basis. Complications of intramedullary nailing like infection, anterior knee pain, implant impingement, compartment syndrome, deep vein thrombosis ,nerve related complications, failure of implant along with nounion and malunion [3].
One of the most common complication is anterior knee pain after intramedullary nailing of tibia fractures. The exact etiology of anterior knee pain after tibia nailing is still debatable and unknown [4]. The probable cause may be a multifactorial and depends on many things such as surgical approach, implant prominence, size of screws used , trauma to fat pad, iatrogenic articular cartilage injury, trauma to surrounding soft tissues etc [5-7].
In our study of 48 cases we retrospectively analysed the patient presented with anterior knee pain after tibial fracture managed with intramedullary nailing via patellar split approach and evaluate the incidence of anterior knee pain and its functional outcome.

Materials and Methods

We evaluated 48 patients treated for tibia shaft fractures with intramedullary interlocking nail at our institute from the period between January 2016- December 2020. Our inclusion and exclusion criteria had been selected as per mentioned below:

Inclusion criteria

Closed tibia shaft fractures
Age > 18 years
Unilateral side involvement

Exclusion criteria

Age < 18 years
Open tibia shaft fractures
Intraarticular involvement of fractures (knne/ankle)
Ipsilateral limb injury other than tibia and fibula shaft fractures

Bilateral tibia fractures

All patients presented to institute were assessed by ATLS protocol and stabilize as per standard trauma protocol. Limb was immobilized with above knne plaster slab or splint. Adequate radiological and laboratory investigations had been done. Patients were taken for surgery as earliest as 6 hours after anesthetic clearance. We have selected patients for our study that were operated by single senior trauma consultant. We evaluated cases by clinic /OPD visits and checked for anterior knee pain. The data in previous clinical entry records in patients record books as well as complaints and outcome of patients were assessed.

Surgical technique

Patient was taken to radiolucent traction table. All tibial shaft fractures treated with patellar spilt approach. Entry point was taken after adequate and gentle retraction of tendon. Entry was taken just medial to lateral tibial spine in AP view and just anterior to superior border of tibia in lateral view with curved entry awl. All patient were treated with reamed intramedullary nail. No expert nail was used in any case. Soft tissue protector used throughout the procedure and minimize the trauma to tendon. Forceful retraction and reaming were avoided at proximal end. adequate sizing of screws were placed. Tendon spilt was closed in layers.

Patient was discharge after post op protocol followed. They have been scheduled for opd/clinic visit at 1 month, 3 months and 6 months interval. Patients were examined with radiographs and modified lysholm score[8] at final follow up of minimum 1 year and maximum follow up 4.5 years.

After one year of index surgery , all patients were evaluated for visual analog scale (VAS) at outpatient clinic [9, 10]. The patients graded their pain during eight point activities such as rest, walking, squatting, running, kneeling, stair climbing, stair descent and long term sitting on 100-mm VAS where 0 stands for no pain,100 stands for worst pain where 0 meant no pain, less than 33 meant mild pain, 33 to 66 meant moderate pain, and greater than 66 meant severe pain.

The radiographs were examined thoroughly in postoperative as well as in follow up.

Distance from tip of the nail to anterior border as well as tip of nail to superior border was noted along with fracture configuration. Serial x ray where evaluated and distance from tip of nail was noted. (figure 1)

No revision of fixation or second surgery done in any case. Implant removal done in 7 cases.

Two cases where infected superficially at distal bolt site which was managed with local dressing and oral antibiotics. They resolved fully after two weeks.

Fig 1: Radiograph with depicted lines showing measurement of tibia nail prominence

a: superior plateau of tibia b: nail tip level c: anterior border of tibia d: superior nail prominence in mm(green line) e: anterior nail prominence in mm (blue line)

Results

We evaluated 48 cases of tibial diaphyseal fracture treated with intramedullary interlocking nails where anterior knee pain after final follow up was noted in 16 patients(33%) where as there were no anterior knee pain in remaining 32 patients (67%). The pain during one or more activities while assessing the VAS. The following activities were taken into consideration for VAS assessment e.g. during rest, walking, running, squatting, kneeling, or stair-climbing or descent, or after long-term sitting. Highest pain was noted while kneeling (14 patients, 29%) and lowest while rest in our study.

In our study we assessed final functional outcome with modified lysholm score where we noted excellent outcome in 30 patients (62%) and good results in 11 patients (23%). Further description of patients with knee pain and without knee pain and their functional outcome was detailed in table 1.

Table 1: Functional outcome according to modified lysholm score

Results	Without knee pain	With knee pain	overall
Excellent	27 (84%)	03 (19%)	30 (62%)
Good	05 (16%)	06 (37%)	11 (23%)
Fair	-	07 (44%)	07 (15%)
Poor	-	-	-
Total	32 patients	16 patients	48 patients

Evaluation of radiographs at every follow up visit and fina follow up visits were noted. At final follow up distance between tip of nail to superior aspect of plateau as well as anterior aspect of tibia were noted. The sum of both were calculated and decided. The incidences of knee pain and its relation with nail apex ytip distance has been shown in table 2.

Table 2: Nail tip apex distance and its incidence with knee pain

Nail apex tip distance	No of cases	No of cases with knee pain
30 mm - <20mm	26 (54%)	02 (13%)
<20mm - <10mm	15 (31%)	08 (50%)
<10 mm	07 (15%)	06 (37%)
total	48 patients	16 patients

Nail apex tip distances with less than 10 mm distance showed highest number of knee pain in our study, where as lowest number of knee pain incidence noted in nail tip apex distances less than 30 mm but more than 20 mm.

Seven patients had been undergone removal of nail where 3 patients were operated for anterior knee pain. After removal of nail these three patients, two had significant reduction of pain and one did not improve significantly. We did not intervene any patient with revision of surgery in any case.

Discussion

The gold standard treatment of tibial shaft fracture in recent era is tibia intramedullary interlocking nail considered by many literatures. The incidence of anterior knee pain after tibia interlocking nail remains a subject of debate as its incidence has been varying study to study.

The average incidence of anterior knee pain after tibia nailing in literature is around ~47% [5].

Causative factors of anterior knee pain followed by intramedullary nailing is uncertain and multifactorial. Some important causes of anterior knee pain were protruded nail, rough handling of patellar tendon, injury to patellar tendon while reaming and insertion of nail, fat pad necrosis, reactive synovitis, iatrogenic articular injury, tendonitis etc.

In their study katsoulis *et al* noted that irrespective of approach used, injury to tendon and soft tissue cannot be avoided, hence degree of per-operative trauma seems one of the most important causative factor for anterior knee pain [5].

The study described by devitt *et al* noted chondromalacia patellae in the patient treated with tibia nail in their arthroscopic examination [11]. The probable reason behind this is increased patellar facetal pressure irrespective of approach likely to cause chondral injury. This can be minimized with more than 100 degree flexion of knee while nailing procedure performed.

The tip of proud nail certainly causing trauma and irritation to fat pad and inner surface of patellar tendon. Nail prominence is one of the important factor which causing anterior knee pain. Sala *et al*. [12] noted changes in tendon substances and reactive synovitis of fat pad In the symptomatic patients with tibia nails. They did MRI in patients with persisting pain even after removal of tibia nail to address the issue where they found tendonitis, chondral pathology and fibrosis changes in fat pad. Incidences are higher in younger patients than the older patients probably due to higher activities which lead to anterior knee pain [4, 6].

Kneeling pain is most commonly associated with superior nail prominence where as resting pain is most commonly associated with rest pain, moreover; nail tip apex distance of less than 25 mm associated with decrease number of knee pain incidences [13]. In our study we noted almost similar findings with them where knee pain incidences are higher when nail tip apex distance is less than 25 mm.

Katsoulis *et al*. [5] presented a recommendation based on their survey for lowering the incidence of knee pain following tibia nailing. They suggested liberal skin incision away from kneeling surface, careful surgical techniques and avoidance of prominence of tibia nail.

There is no clear consensus and association between surgical approach (trans-tendinous vs medial paratendinous) and incidence of anterior knee pain [4].

Vaisto *et al* [14] noted in their series of 36 patients that ultrasound changes of patellar tendon was similar in patients with knee pain and without knee pain and based on it they did not find any differences to approach (paratendinous or transtendinous) in the incidence of anterior knee pain.

The position in which tibia nail should be done confers minimum trauma to surrounding soft tissues. The flexion of knee is one of the important position where iatrogenic tendon and soft tissue trauma can be minimized. The limiting trauma to extensor mechanism probably helps in alleviate causative factor of anterior knee pain.Callaghan *et al* noted pain causes reflex inhibition of quadriceps with subsequent atrophy [15].

In our study we noted almost similar incidences of knee pain followed by tibia nail in literature [4, 5, 10] The exact etiopathogenesis of anterior knee pain is still not clear. chances of anterior knee pain cannot be predicted but can be minimized with correct placement of incision, cautious use of reamer , correct size of nail and screws as well as adequate analgesia and stringent rehabilitation protocol. Placement of incision based on patients day to day activity where kneeling is involved should be generous enough and away from directly involved area while kneeling. Protection of soft tissue with tissue guard is necessary throughout the procedure of reaming and nail insertion. Adequate Flexion of knee lessens the pressure over chondral surfaces of patella during the procedure. Protrusion of nail; studied by many in literature remains one of the important cause of knee pain hence avoided . correct sizing of proximal screws obviates the irritation to surrounding soft tissue at proximal as well as distal portion may limit the knee pain. The importance of analgesia cannot be overlooked. The decrease in pain confers early rehabilitation and activity which prevents the atrophy of muscles around knee. This in turn ultimately helps in probable knee pain due to muscle imbalances.

As our study is not a comparable study with limited number of cases, in future more randomized control trial as well as research in similar case series is advised to establish evidences to lessen the incidences of anterior knee pain after tibia nailing.

Conclusion

Anterior knee pain after tibia nailing is not so uncommon complications and remains almost top in the list. Proper pre op planning, careful surgical technique, limited perioperative trauma, avoidance of protrusion of nail by choosing correct size and placement, adequate analgesia along with early rehabilitation protocol may limit the chances of anterior knee pain after tibia nail.

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