Original Article

Quadriceps Strength and Anterior Knee Pain following Tibia Intramedullary Nailing: Any Clinical Relationship?

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A B S T R A C T

Introduction: Anterior knee pain can be chronic sequelae of intramedullary nailing of the tibia. Several causes have been identified; no single reason can fully explain the occurrence. We, therefore, set out to find the rate of anterior knee pain in our practice and if any relationship exists between the anterior knee pain and extensor muscle strength. **Methodology:** A total of 72 knees in 36 patients with no prior history of knee pain, but had unilateral tibiofibular fracture, who had internal fixation with interlocking intramedullary nailing done and were followed up for at least 1 year were recruited into the study. The tension generated on extension of the knee against a resistance using tensiometer was measured in Newton. The ranges of motion of the knees were documented, as well as Lysholm score which measures activities and document the presence and limitation caused by anterior knee pain. **Results:** A total of 36 patients with 72 knees were studied. Anterior knee pain occurred in 7 (19.4%) patients in this study. There was no statistically significant relationship between the force of tension (N) generated in the extensor in patients with anterior knee pain compared with those without knee pain (158.43 ± 49.35, 189.54 ± 74.63, P = 0.304). There was, however, a significant statistical relationship between the mean Lysholm score of the operated and unoperated knee (P = 0.042). **Conclusion:** Anterior knee pain rate was 19.4% in our series and no statistical association exists between the extensor strength and occurrence of anterior knee pain.

KEYWORDS: *Anterior knee pain, intramedullary nailing, quadriceps*

INTRODUCTION

*P*ostoperative anterior knee pain and discomfort are one of the common chronic complications following intramedullary nailing of tibia shaft fractures.[1-4] As such the quality of life of such patients is affected. Several publications have suggested reasons why anterior knee pain occurs, ligament instability, retropatellar fat necrosis and irritation, meniscal and cartilage damage, gait changes, tendonitis, and inadequate neuromuscular rehabilitation have been suggested as possible causes.[5] Thigh muscle strength deficits have also been reported after intramedullary nailing of tibial shaft fractures,[6,7] and this has been suggested as a cause of anterior knee pain. Yet, there are no conclusive data regarding the etiology of anterior knee pain and it remains a complex problem.

The process of surgery involves the breach of the knee anatomy in inserting the nail from proximal end of the tibia whether by open or closed method. Any of the structures around the knee can be affected. In transpatellar approach, the patella tendon is breached by direct incision through its substance. However, the patella tendon is repaired after the procedure with absorbable sutures. It may take several months for healing and subsequent restoration to preinjury tensile strength. Since the patellar ligament is part of the extensor mechanism, its disruption may translate to subsequent deficit of the quadriceps strength.

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This study was done with the aim of determining the relationship between anterior knee pain and extensor muscle weakness measured as tension force (Newton) generated by the quadriceps muscle following intramedullary nailing for tibia shaft fracture. Patients that were considered for the study must have had a minimum of 1-year follow-up following the surgery. The other unoperated limb served as control.

METHODOLOGY

It was a prospective study done at tertiary health institution, Southwest Nigeria. Thirty-six patients who presented with unilateral tibia fracture met inclusion criteria, and consented were recruited into the study. The study was done in accordance with the Helsinki protocol. They had intramedullary nailing using the Surgical Implant Generation Network nail and were followed up for at least 1 year after surgery. All the patients had similar rehabilitation protocol postsurgery. Patients with preinjury weakness of the extensor mechanism, prior knee pain, and those with bilateral tibia fractures were excluded from the study. The uninjured pair of limb served as control in these patients.

The strength of the extensor mechanism was assessed by measuring the tension force (N) generated in the operated as well as the unoperated pair of the limb using a tensiometer (Hana brand, Japan) and these were compared. The tensiometer was strapped to the leg of the patient with its other end attached to a transverse bar at the foot of the couch. The patient was made to sit at the edge of the couch with the hip and knee in 90° of flexion. The patients were then made to extend the knee against the resistance offered by the tensiometer. The tensiometer is graduated in kilograms (kg) and the highest stable reading was recorded. This was done against the acceleration due to gravity measured in meters/seconds (10 m/s); hence, readings in kg were multiplied by the acceleration due to gravity (10 m/s) to obtain the Tension force generated by the knee extensor in Newton. The reading was taken as soon as the peak of extension was reached. Three readings were taken in intervals with the average recorded in Newton. This process was repeated for the unoperated pair.

The range of motion was recorded for both operated and the unoperated pair with the patients in the prone position on the couch with the knee in full extension. Patients were thereafter asked to actively flex the knees and readings were taken with the aid of goniometer. Lysholm score was also recorded at follow-up. This questionnaire (Lysholm) is designed to assess how the knee problem has affected the ability to manage in everyday life. It measures 8 parameters, including the presence and severity of knee pain, and the maximum score is 100. Higher score signifies better outcome. Other information such as age, weight, height, body mass index (BMI), level of fractures, type of fracture, and approach used among others were recorded. The distance between the base of the nail and joint line and between the base of the nail and tibia tuberosity was measured on lateral view radiograph. The base of the nails was either sunk below the level of the cortex or at least flushed with the cortex to prevent irritation of the patellar tendon. Anterior nail prominence was also evaluated.

RESULTS

A total of 36 patients met the inclusion criteria for this study. Twenty-eight (77.8%) patients were below 46 years of age with a male to female ratio of 2.6:1. Nine (25%) patients were overweight (5.5%), two were obese while the rest were of normal BMI. Most of the patients (52.8%) had middle-third fracture. In our study, seven (19.4%) patients had anterior knee pain, with three of them having the pain at mild exertion such as walking while four patients had the pain after jogging or running (severe exertion) One of these patients had prominent nail from erosion around the interlocking screws leading to proximal migration of the nail with irritation of the patellar tendon. The nail was removed with the resolution of symptom. There was no significant difference with respect to the mean BMI in those with anterior knee pain and those without anterior knee pain. However, we observed a significant relationship between the etiology of the fracture and occurrence of anterior knee pain ($P = 0.048$) [Tables 1 and 2].

Table 1: Comparison of respondents characteristics with presence or absence of anterior knee pain

Variable	Anterior knee pain (n=7), n (%)	No pain (n=29), n (%)	P
Gender			
Male	5 (71.42)	21 (72.41)	1.000
Female	2 (28.57	8 (27.59)	
Side			
Right	2 (28.57)	18 (62.07)	0.204
Left	5 (71.42)	11 (37.93)	
Facture level			
Upper 1/3	0	4 (13.79)	0.241
Middle 1/3	3 (42.85)	16 (55.17)	
Lower 1/3	4 (57.14)	9 (31.03)	
Approach			
Transpatellar	6 (85.71)	23 (79.31)	1.000
Parapatellar	1 (14.29)	5 (17,24)	
Tourniquet	3 (42.85)	4 (57.15)	0.650
Fracture type			
Closed	2 (28.57)	13 (44.83)	0.647
Open	5 (71.43)	16 (55.17)	

Table 2: Comparison of means of respondents characteristics with the absence or presence of anterior knee pain

Variable	Anterior knee pain (*n*=7)	No pain (*n*=29)	Statistical test; degree of freedom	CI	*P*
Age	42.29±18.43	37.17±13.76	*t*=0.826; df=34	−0.826; df=34	0.415
Range of motion	104.14±15.23	113.72±22.88	*t*=−1.047; df=34	−1.047; df=34n	0.302
Tension (N)	158.43±49.35	189.54±74.63	*t*=−1.043; df=34	91.7204–29.5017	0.304
Lysholm score	82.14±17.54	99.17±2.84	*t*=−2.560; df=34	−2.560; df=3	0.042

CI=Confidence interval

Use of tourniquet was not significantly associated with the occurrence of anterior knee pain in the patients studied as shown in Table 1. The mean tension (N) generated in the operated limb was 183.47 ± 70.91 while that of the unoperated limb was 223.03 ± 91.98 ($t = -2.04$, df =70, confidence interval [CI] = −78.14 to −0.93, $P = 0.045$). Similarly, the mean range of motion in the operated knee 111.861 ± 21.76 was compared with that of the unoperated knee 118.19 ± 15.42, ($t = -1.42$, 95% CI = −15.20–2. 53, df =70, $P = 0.159$). This was not significant statistically.

DISCUSSION

This study showed anterior knee pain in 19.5% of our patients at minimum of 1-year follow-up following tibia interlocking nail. This reported prevalence is lower compared with reports from the previous works done by other authors who gave higher prevalence rate of an average of 57%.[2] We used both trans- and para-patella approaches with no significant difference between the two in terms of anterior knee pain outcome. Three prominent nails in three of our patients with pain on mild exertion of the knee were removed because of excessive anterior prominence (>5 mm). This we considered proud enough to irritate the patella ligament and cause anterior knee pain which they had. This was treated with removal and resulted in significant improvement in the symptom. Apart from this, most of the patients with the knee pain had it only on severe exertion, and this did not affect their activity of daily living. They did not require intervention as it did not affect their activities of daily living. The mean tension generated in the unoperated knee quadriceps was higher than in the operated knee as at 1 year of follow-up. This deficit in the quadriceps strength was also observed by Väistö *et al.*, who still observed deficit in the quadriceps of patients who has anterior knee pain as at 8 years of follow-up.[8] However, in this study, this difference was not significant statistically (189.54 ± 74.63, 158.45 ± 49.35, $P = 0.304$). It is possible that patient continues to recover for a long time after surgery and those with anterior knee pain may never get back to the preinjury state. Patient's inability to cope with rehabilitation protocols may be a factor to consider in weakness of the quadriceps. Kobayashi *et al*. in their study still found the muscle strength to

have recovered up to 90% of the uninvolved limb after 2 years of surgery following anterior cruciate ligament reconstruction.[9]

Similar observation was made about the range of motion between the operated and unoperated knee. This was not statistically significant. They all had useful range of motion of their joints necessary for their daily activities. The activity score involving the use of the knee using Lysholm score showed a significant difference between the patients that had knee pain and those without knee pain (99.17 ± 2.84, 82.14 ± 17.54, $P = 0.042$). This stands to reason as pain is expected to limit the activities that are tolerated with the knee; this in turn may lead to weakness of the muscles around the knee, especially the quadriceps as it is in the case in our study.

Fracture level did not show any significant statistical relationship with anterior knee pain. The likelihood ($P = 0.241$) of the pain occurring following whether the fracture is in the upper, middle, or lower third was not significant. Once the fracture is united, the bone moves as a single piece under the influence of the muscles (extensors and flexors), the level of the fracture does not matter.

CONCLUSION

The knee extensors mechanisms were found to be weaker than the contralateral unoperated knee in our study though this finding was of no statistical significance. There was no association between the strength of the quadriceps and anterior knee pain.

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Conflicts of interest
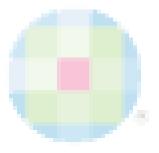There are no conflicts of interest.

REFERENCES

1. Court-Brown CM. Reamed intramedullary tibial nailing: An overview and analysis of 1106 cases. J Orthop Trauma 2004;18:96-101.
2. Keating JF, Orfaly R, O'Brien PJ. Knee pain after tibial nailing. J Orthop Trauma 1997;11:10-3.
3. Kyrö A. Malunion after intramedullary nailing of tibial shaft fractures. Ann Chir Gynaecol 1997;86:56-64.
4. Toivanen JA, Väistö O, Kannus P, Latvala K, Honkonen SE,

Järvinen 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:580-5.

5. Väistö O, Toivanen J, Paakkala T, Järvelä T, Kannus P, Järvinen M, *et al.* Anterior knee pain after intramedullary nailing of a tibial shaft fracture: An ultrasound study of the patellar tendons of 36 patients. J Orthop Trauma 2005;19:311-6.

6. Väistö O, Toivanen J, Kannus P, Järvinen M. Anterior knee pain and thigh muscle strength after intramedullary nailing of tibial shaft fractures: A report of 40 consecutive cases. J Orthop Trauma 2004;18:18-23.

7. Nyland J, Bealle DP, Kaufer H, Johnson DL. Long-term quadriceps femoris functional deficits following intramedullary nailing of isolated tibial fractures. Int Orthop 2001;24:342-6.

8. Väistö O, Toivanen J, Kannus P, Järvinen M. Anterior knee pain and thigh muscle strength after intramedullary nailing of a tibial shaft fracture: An 8-year follow-up of 28 consecutive cases. J Orthop Trauma 2007;21:165-71.

9. Kobayashi A, Higuchi H, Terauchi M, Kobayashi F, Kimura M, Takagishi K, *et al.* Muscle performance after anterior cruciate ligament reconstruction. Int Orthop 2004;28:48-51.