Anterior Knee Pain After Intramedullary Tibia Nailing in A Muslim Society: A Prospective Randomized Study Comparing Two Different Nail Insertion Techniques

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ABSTRACT

Objective: To compare mean anterior knee pain score on cyclical kneeling at 12 weeks from intramedullary nailing for tibia shaft fractures with paratendinous approach versus transtendinous approach at a tertiary health care centre.

Methods: 157 patients admitted with tibia diaphyseal fractures who subsequently underwent antegrade tibia nail insertion were enrolled in the study. The patients were divided in two groups. Group A consisted of patients underwent antegrade nail insertion using transtendinous approach and Group B underwent nail insertion using paratendinous approach. A standard study proforma was used to collect patient's data and to record pain on kneeling on ground using a 100 mm Visual Analog Score (VAS). The assessment for pain was performed by a physician who wasblinded for the type of surgical approach that was used for nailing of tibia.

Results: Mean age of patients in group A 35 ± 10 and in group B 36 ± 11 with P- value 0.655 which was statistically insignificant, similarly BMI was statistically insignificant as BMI 28 ± 6 and 26 ± 4 for group A and B respectively with insignificant P- value (0.073). After surgery, VAS scoring was done for anterior knee pain on cyclical kneeling at 12 weeks of surgery. Statistically, there was no significant difference in the score among the two study arms as 22 ± 8 and 21 ± 10 VAS evaluated in group A and B respectively with P- value (0.709).

Conclusion: The choice of surgical approach, transtendinous versus paratendinous does not affect the outcome of antegrade tibia nailing with respect to anterior knee pain. There was no increase incidence of anterior knee pain associated with either of the two approaches. Therefore both approaches can be safely used to cite the entry portal for tibia nail insertion. Further detailed studies are required to study more causes of anterior knee pain.

Key Words: Anterior Knee Pain, Intramedullary Nailing, Tibial Fractures.

INTRODUCTION

Historically, multiple methods have been described for treating tibia diaphyseal fractures. These methods include non-operative treatment with casts and functional brace [1] to operative treatment using different external and internal fixation devices. The use of the reamed intramedullary nail was introduced by Küntscher in 1958 [2] and has now become the standard treatment for closed and Gustilo Type I open fractures [3,4]. Nevertheless the technique originally described by Küntscher has been modified after that. One of the commonly argued technical aspect is the surgical approach used for citing the entry portal [3,5].

Anterior knee pain after tibia nailing is a well-documented complication after antegrade tibia nailing with reported incidence in the range of 47% to 70% [6,11]. In a Muslim society like Pakistan, this could have a significant social impact as kneeling in prayers demands high degrees of knee flexion >150°. Surgical approach for nail insertion is one factor that has been discussed as a variable that could affect outcome [8].

The transtendinous approach described by surgical manuals [5] has been used traditionally for citing the entry portal of nail insertion. It was reported a higher incidence of knee pain with transtendinous approach as compared to the newer paratendinous approach (77% versus 50%) [6,7]. But some studies showed disagreement and demonstrated no

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significant difference in severity of knee pain between the two approaches. The Muslim society is a special group with regards to the routine practice of kneeling and squatting in prayers that requires repeated cyclical movements. This practice can be seriously hampered by chronic anterior knee pain. To the best of author's knowledge no study has been conducted that addresses a single ethnic group taking into account their specific functional needs. This study was designed to study the effect on pain using either of the two different surgical approaches in a Muslim population.

METHODS

This was a randomized controlled trial. Study was conducted from November 2010 to May 2012. Patients were registered using a predesigned Performa. Approval from institutional ethical review committee was taken prior to commencement of the study. Formal informed written consent was obtained from patients registering in the study. Using a non-probability, consecutive sampling technique 157 patients were initially registered for the study. Inclusion criteria were either gender with age between 18 – 60 years admitted to the Orthopaedic Surgery service at LNH with traumatic isolated tibia closed or open Gustilo Anderson [12] Type 1 fracture. Based on AO Classification (fracture classification system proposed by Association forInternal Fixation of Fractures "AO Foundation") [13] for fracture morphology only 42 A and 42 B and their subtypes were included. Restricting the fracture morphology types as mentioned here controlled the effect modifiers.

Seven patients were dead during follow-up time. 2 patients were omitted, as they were non-Muslims. 3 patients were having complications during follow-up time, (2 superficial surgical site infection and 1 deep seated surgical site infection) compromising their return to function and altering their VAS for pain. Another patient showed no signs of healing up to the 12 weeks of follow-up period for the study and had a secondary procedure and was therefore excluded from the study group. Total of 13 patients were excluded from study as per exclusion criteria and finally left a total of 144from 157 patients, out of which 72 were randomized to each intervention arm using sealed envelopes. Group A consisted of patients who subsequently underwent antegrade tibia nailing of their injury using the transtendinous approach and Group B consisted of those who underwent nailing using the paratendinous approach. Size of nail used in both arms in length ranges from 320mm to 420mm with diameter of 10mm to 13mm with one proximal and two distal screws in static locking mode were used to fix the fracture. Protrusion of proximal nail were as per standardized in all patients among both groups to nullify its effect in both groups's patients.

All cases were operated by surgeons with at least three years of experience of orthopedic surgery (resident year III or consultant orthopedic surgeon). Out of 144 only 9 patients underwent dynamization of tibia nailing. Patients were followed up in the outpatient office at approximately 2, 6, 9 and 12 weeks from surgery, meanwhile post operatively physiotherapy were performed in all patients to gain knee range of motion and strengthening of muscles. The earliest assessment of patients for pain by VAS starts at 2 weeks after stiches removal and wound healing and afterward at 6, 9 and 12 weeks to minimize the effect of wound and physiotherapy on anterior knee pain. They were asked to express the degree of anterior knee pain on performing maximum knee flexion at 2, 6 and 9 and 12 weeks. This was marked on a 100mm Visual Analogue Scale (VAS). Knee pain on kneeling on the ground was assessed only at 12 weeks when sufficient fracture healing had occurred allowing them to bear weight and safely perform the task. A single blinded physician assessed patients for their ability to kneel repeatedly over a period of time (10 cycles per minute for 3 minutes - total 30 cycles) and then re-evaluated their pain over a VAS. With the above information the two approaches for their impact on incidence and severity of knee pain and limitation of the patient's ability to kneel in prayers were evaluated.

Data was entered in SPSS 17.0 statistical package. Continuous variables i.e. age, BMI and VAS for pain were analyzed as mean ± SD. Categorical variables i.e. approach and sex were analyzed as proportions and percentages. Statistical comparison of pain scores was made between the two groups using t-test. P-value of <0.05 was taken as significant. Additional stratification was done for age, gender and BMI to see the effect of these variables on the outcomes.

RESULTS

There was an insignificant difference between the two groups (paratendinous approach and transtendinous approach) in distribution with respect to age, gender, height, weight and BMI, which indicates matching of the two groups in these characteristics (Table I).

Table I: Distribution of patients with respect to age, gender, height, weight, and Body Mass Index.

Intervention Groups	Age (yrs)	Gender	Height (cm)	Weight (kg)	BMI (kg/m^2)
Group A (n=72) Transtendinous Approach	35 ± 10	Males = 62 (86.1%) Females = 10 (13.9%)	165 ± 11	76 ± 15	28 ± 6
Group B (n=72) Paratendinous Approach	36 ± 11	Males = 67 (93.1%) Females = 5 (6.9%)	167 ± 11	74 ± 13	26 ± 4
P-Value Test of Significance	0.655 (t-test)	0.173 (chi-squared)	0.150 (t-test)	0.444 (t-test)	0.073 (t-test)

Figures are in mean ± SD. Paired t-test was used for comparative analysis.
Statistically significant p-value < 0.05

Table II: Comparison of Visual Analogue Scale score for pain.

Intervention Groups	VAS on Maximum Knee Flexion				VAS after Cyclical Kneeling at 12 weeks
	2 weeks	6 weeks	9 weeks	12 weeks	
Group A (n=72) Transtendinous Approach	47 ± 14	32 ± 14	20 ± 12	12 ± 8	22 ± 8
Group B (n=72) Paratendinous Approach	48 ± 16	31 ± 14	19 ± 13	11 ± 10	21 ± 10
P-Value Test of Significance	0.700 (t-test)	0.593 (t-test)	0.645 (t-test)	0.709 (t-test)	0.709 (t-test)

Figures are in mean ± SD. Paired t-test was used for comparative analysis.
Statistically significant p-value < 0.05

Table III: Effect of Different Variables on VAS score for pain.

Categories	VAS on Maximum Knee Flexion				VAS after Cyclical Kneeling at 12 weeks
	2 weeks	6 weeks	9 weeks	12 weeks	
Effect of Age					
Young Patients (n=128) < 50 yrs of age	47 ± 15	32 ± 14	20 ± 12	11 ± 8	22 ± 8
Elder Patients (n=16) > 50 yrs of age	44 ± 15	31 ± 16	20 ± 16	11 ± 12	21 ± 12
P-Value (Test of Significance)	0.459 (t-test)	0.883 (t-test)	0.981 (t-test)	0.717 (t-test)	0.717 (t-test)
Effect of Gender					
Male (n=129)	47 ± 15	31 ± 14	20 ± 12	11 ± 8	21 ± 8
Female (n=15)	49 ± 16	35 ± 16	23 ± 16	15 ± 13	25 ± 13
P-Value (Test of Significance)	0.655 (t-test)	0.293 (t-test)	0.376 (t-test)	0.070 (t-test)	0.070 (t-test)
Effect of BMI					
Normal (n=99) (BMI < 30)	47 ± 14	32 ± 13	20 ± 12	11 ± 8	21 ± 8
Obese (n=45) (BMI > 30)	47 ± 18	31 ± 15	20 ± 13	12 ± 09	22 ± 9
P-Value (Test of Significance)	0.856 (t-test)	0.816 (t-test)	0.811 (t-test)	0.725 (t-test)	0.725 (t-test)

Figures are in mean ± SD. Paired t-test was used for comparative analysis.
Statistically significant p-value < 0.05

After surgery, VAS scoring was done for anterior knee pain on maximum knee flexion at different intervals (2, 6, 9 and 12 weeks of surgery) and on cyclical kneeling at 12 weeks of surgery. Statistically, there was no significant difference in these scores among the two study arms (Table II).

At last, we also assessed the effect of age, gender and BMI on degree of anterior knee pain through same VAS scoring. The difference in degree of anterior knee pain after antegrade tibia nailing among the two genders, different age groups and the two groups with different BMI was also found statistically insignificant (Table III),

DISCUSSION

Tibia fractures are one of the most common orthopaedic injuries. There is a clear male pre-dominance and most patients are in the young active years of life [14] Modern fracture treatment aims at restoration of weight bearing and joint function as early as possible. Intramedullay interlocking nail for tibial diaphyseal fractures is now the gold standard for management of closed as well as certain open fractures [3, 4, 15, 16]. It allows the surgeon to internally splint a fracture without disturbing the fracture hematoma [17].

Most implant manufacturers have incorporated a curve in the proximal region of the nail, the so called Herzog bend [18]. The Herzog bend ensures that the nail does not hit the posterior cortex and causes an iatrogenic fracture. It allows entry of the nail from the triangular area over the anterior edge of the tibial plateau in line with the lateral tibial spine [6,19-22]. This triangular area lies posterior to the patellar tendon and the surgeon has to either split or retract the tendon to access it [23].

Chronic anterior knee pain is probably one of the most common aftereffects experienced by the patient after antegrade tibia nailing. . A number of causes have been cited in literature as the cause of this pain including proximal protrusion of the nail, ligament instability, retropatellar fat necrosis and choice of the surgical approach all indicating that either injury, scarring or chronic irritation of the tendon is the likely mechanism [6-11]. Knee pain can significantly hamper the patient's ability to perform tasks such as climbing stairs, squatting and kneeling. Although previous studies have looked at various functional outcome measures using knee scoring systems and VAS score for pain for different activities performed by the patient [7-11], no study has targeted a single ethnic group. The Muslim faith requires the person to perform repeated cyclical kneeling when performing the sala'at. This subjects the patellar tendon to considerable stress and forceful grinding against the anterior edge of the tibial plateau when loading in high flexion. Our study intended to evaluate the impact of the choice of the trantendinous versus the paratendinous approach on incidence of anterior knee pain in practicing muslim patients.

It is clear from our results that VAS scores for pain were comparable at 12 weeks follow-up for both groups when evaluated after performing cyclical kneeling and there was no statistical difference between the two groups. The cyclical kneeling was depictive of the forces that act on the knee joint during kneeling in prayers practiced by the muslim faith. Our results are supportive of the evidence published by Toivanen 2002 [9] . Our results also indicated that factors such as age, gender and BMI had no bearing whatsoever on the incidence of anterior knee pain.

Katsoulis 2006 [8] have advised to avoid the transtendinous approach due to the higher incidence of anterior knee pain associated with it. We find that our study does not agree with their findings. Probably other factors such as nail protrusion, muscle weakness and ligamentous or meniscal injury need to be looked at as probable causes [7, 8, 11].

The limitations of our study are that it was single centre trial and the follow-up period was shorter as compared to most other studies. We also did not evaluate any other factors besides the surgical approach and still have to evaluate our patient population for persistence of knee pain once the implant is removed. Our study arguably adds to the pool of data available on the topic however due to the aforementioned limitations, we require further studies and a long-term follow-up of our patients to increase the strength of our findings.

CONCLUSION

From our study we conclude that the incidence of knee pain is similar regardless of the fact that the patellar tendon is split or retracted and spared. Therefore the entry portal for antegrade tibia nailing depending upon surgeon preference and experience can safely be made using both approaches. Probably nail protrusion and other factors such as ligamentous/menisceal injury or fat pad necrosis are more causative of the knee pain rather than the tendon scarring itself. Further studies

comparing more parameters with long terms follow up would be required to probe this argument further.

REFERENCES

1. Sarmiento A. Gersten LM. Sobol PA. Shankwiler JA. Vangsness CT. Tibial shaft fractures treated with functional braces. Experience with 780 fractures. J Bone Joint Surg. Br. 1989 Aug;71(4):602-9.
2. Kuntscher GB. The Kuntscher method of intramedullary fixation. J Bone Joint Surg Am. 1958 Jan;40-A(1):17-26.
3. Court-Brown CM. Christie J. McQueen MM. Closed intramedullary tibial nailing. Its use in closed and type I open fractures. J bone Joint Surg Br.1990 Jul;72(4):605-11.
4. Keating JF. Brien PJ. Blachut PA. Meek RN. Broekhuyse HM. Locking intramedullary nailing with and without reaming for open fractures of the tibial shaft. A prospective, randomized study. J Bone Joint Surg Am. 1997 Mar;79(3):334-41.
5. Muller ME. Allgower M. Arbeitsgemeinschaft für Osteosynthesefragen. Manual of internal fixation : techniques recommended by the AO-ASIF Group.1991;3:750.
6. Orfaly R. Keating JE. Brien PJ. Knee pain after tibial nailing: does the entry point matter? J Bone Joint Surg Br. 1995 Nov;77(6):976-7.
7. Keating JF. Orfaly R. Brien PJ. Knee pain after tibial nailing. J Orthop Trauma. 1997 Jan;11(1):10-3.
8. Katsoulis E. Court-Brown C. Giannoudis PV. Incidence and aetiology of anterior knee pain after intramedullary nailing of the femur and tibia. J Bone Joint Surg Br. 2006 May;88(5):576-80.
9. Toivanen JA. Vaisto O. Kannus P. Latvala K. Honkonen SE, Jarvinen MJ. 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 Apr;84-A(4):580-5.
10. Vaisto O. Toivanen J. Paakkala T. Jarvela T. Kannus P. Jarvinen M. 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 May-Jun;19(5):311-6.
11. Vaisto O. Toivanen J. Kannus P. Jarvinen 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 Jan;18(1):18-23.
12. Gustilo RB. Merkow RL. Templeman D. The management of open fractures. J Bone Joint Surg Am.1990 Feb;72(2):299-304.
13. Muller ME. The comprehensive classification of fractures of long bones. Berlin Hong Kong. 1990;201.
14. Court-Brown CM. McBirnie J. The epidemiology of tibial fractures. J Bone Joint Surg Br.1995 May;77(3):417-21.
15. Maurer DJ. Merkow RL. Gustilo RB. Infection after intramedullary nailing of severe open tibial fractures initially treated with external fixation. J Bone Joint Surg Am.1989 Jul;71(6):835-8.
16. Quirke TE. Sharma PK. Boss WK. Oppenheim WC. Rauscher GE. Are type IIIC lower extremity injuries an indication for primary amputation. J Trauma. 1996 Jul;40(6):992-6.
17. Whelan DB. Bhandari M. McKee MD. Guyatt GH. Kreder HJ. Stephen D. et al. Interobserver and intraobserver variation in the assessment of the healing of tibial fractures after intramedullary fixation. J Bone Joint Surg Br. 2002 Jan;84(1):15-8.
18. Herzog K. Nailing of fractures of tibial shaft with a fixed nail. Langenbecks Archiv fur klinische Chirurgie vereinigt mit Deutsche Zeitschrift fur Chirurgie. 1953;276:227-9.
19. Brinker MR. Cook SD. Dunlap JN. Christakis P. Elliott MN. Early changes in nutrient artery blood flow following tibial nailing with and without reaming: a preliminary study. J Orthop Trauma. 1999 Feb;13(2):129-33.
20. Finkemeier CG. Schmidt AH. Kyle RF. Templeman DC. Varecka TF. A prospective, randomized study of intramedullary nails inserted with and without reaming for the treatment of open and closed fractures of the tibial shaft. J Orthop Trauma. 2000 Mar-Apr;14(3):187-93.
21. Keating JF. Brien PI. Blachut PA. Meek RN. Broekhuyse HM. Reamed interlocking intramedullary nailing of open fractures of the tibia. Clin Orthop Relat Res.1997 May;338:182-91.
22. McConnell T. Tornetta P. Tilzey J. Casey D. Tibial portal placement: the radiographic correlate of the anatomic safe zone. J Orthop Trauma. 2001 Mar-Apr;15(3):207-9.
23. Tornetta P. Riina J. Geller J. Purban W. Intraarticular anatomic risks of tibial nailing. J Orthop Trauma. 1999 May;13(4):247-51.