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ORIGINAL ARTICLE

Comparison of two methods of Transpatellar and Parapatellar for Anterior Knee Pain after Intramedullary Nailing of Fractures of the Tibial Shaft

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ABSTRACT
Tibial shaft fractures is considered as one of the most common fractures that can cause various complications and therefore may create many problems in the process of personal and social life. However, previous studies show that there are disagreements over selecting the best way of treatment in using transpatellar and parapatellar in the treatment of fracture of tibia and fibula in reducing complications such as pain. The aim of this study is to compare two methods of transpatellar and parapatellar for Anterior Knee Pain after Intramedullarynailing of fractures of the tibia shaft. In this clinical trial study, Imam Khomeini and Golestan hospitals patients with tibial shaft fractures were randomly divided into two groups: transpatellar approach(TP) and lateral parapatellar approach (PP).After 2 weeks and after 6 months (almost 25 weeks) of surgery, assessment of knee range of motion, intensity of knee pain, and thigh muscle atrophy were made, respectively. Data were analyzed using SPSS 21. Full knee range of motion at 2 weeks after surgery in parapatellar group was significantly more than the transpatellar group (P<.05). However, at 6 months after surgerythey were the same (P>.05).Although full knee range of motion after 6monthsfrom surgery increased significantly (P<.05), intensity of knee pain at 2 weeks and 6 months after surgery inparapatellar group was significantly less than the transpatellar group (P<.05).Although the intensity of knee pain after 6monthsdecreasedsignificantlyin two groups(P<.05), thigh muscle atrophy at 2 weeks and 6 months after surgery was the same in both groups(P>0.05). In other words, thigh muscle atrophydid not change in both groups after 6 months from the surgery(P<0.05).Intensity of knee pain after 6 months from interlokingnail of fractures of the tibial shaf tinparapatellar(pp) group was lower than the transpatellar group (TP). No significant difference was observed between transpatellar and parapatellarmethodsin terms of full knee range of motion and thigh muscle atrophy. Also, we recommend future studies with a longer term follow up time.
Keywords: *fractures of tibial shaft, parapatellar, transpatellar.*

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INTRODUCTION

Tibial shaft fractures is considered as one of the most common fractures that can cause various complications and therefore may create many problems in the process of personal and social life [1]. Although several methods (from cast to surgery)have been proposed to treat this sort of fracture, the preferred procedure is the one which, spending the least costs and having least complications, leads to a faster patient's mobility and rehabilitation [2]. At present, the most common method of treating tibia shaft fractures is the insertion of a rod inside the bone's canal (Interlocking nailing; also known as intramedullary nailing) [3-8]. In intramedullary nailing procedure, the patient is rehabilitated faster. This method, however, has its own complications, requires special equipment, and often, due to anterior knee pain, the nailed instrument has to be removed after a while [9]. In many studies, chronic knee pain at the

nailed part has been reported to be the most common complication of this method [10-15] and its prevalence has been reported to exceed 86% [16-17].
In recent years, many studies have been carried out to find the causes of knee pain after tibial nailing. However, in spite of suggesting several predicting factors including surgical procedures, protrusion of the nail, thigh muscle force (strength), iatrogenic intra-articular injury or damage to the patellar tendon and Hoffa fat pad, damage to the infrapatellar branch of saphenous nerve, its etiology is still unknown [18-28].
The nail can be inserted from several positions and determining the best entry point in order to reduce postoperative pain after surgery procedures is still debatable (29). Some researchers have concluded that the prevalence of knee pain in transpatellar approach, due to nail protrusion, is higher than parapatellar procedure [13, 29-30]. Alternatively, others have found no difference with regard to pain between the two surgical procedures several years after nailing [18-31].
Accordingly, as there are disagreements(as mentioned above) over choosing transpatellar or parapatellar method as the best treatment procedure for tibial shaft fracture to reduce complications such as pain, this study aims to examine the advantages and disadvantages of the two methods in terms of the severity of knee pain after surgery.

MATERIALS AND METHODS

In this study, patients referred to Imam Khomeini and Golestan hospitals (located in Ahvaz, Iran) with tibial shaft fractures were examined as the participants (2014-2016).They were operated using intramedullary. The two operational approaches were randomly determined for the two groups. In the first group transpatellar(TP) approach was used, while in the second group lateral parapatellar (PP) approach was employed.
The following people were included in the study: aged over 18, tibial diaphyseal fracture, closed or open fracture with intramedullary nailing indication; the following were excluded from the study: those who were diabetics, immunodeficiency, open fracture without intramedullary nailing indication, history of previous fracture in the knee and chronic anterior knee pain prior to fracture.
We tried to match the patient of two groups or fracture pattern before surgery.
Knee pain intensity of each patient was measured based on the standard of 100-mm visual analog scale (VAS), where the intensity is a number between zero to 100.In this scale, zero denotes no pain and 100 refers to the most intense pain that the patient could imagine (33).
Also, disorder of knee pain was assessed using this criterion, where zero means no disturbance, less than 33 refers to mild disturbance, from 33 to 66 implies an average disturbance, and more than 66 indicates sever disturbance. In general, standardized rating scales for the severity of knee pain were collected for all patients based on the VAS.They are described by the three scoring methods of Tegner, Lysholm, and Lowa.
Demographic characteristics and surgical data of patients were as follows: age, sex, location of the fracture, fracture type, mode of injury, atrophy of the quadriceps muscle, the size of nail protrusion, and the length of hospitalization.
The intensity of knee pain in patients was measured on the basis of VAS in 2stages: 2 weeks and 3 months after surgery.
All patients in the two groups were matched in terms of age, gender and so on.

RESULTS

In this study, 80patients with tibial shaft fractures, who met the criteria of the study were included as the participants of the study.50% (40 people) were in the transpatellar approach group and 50% (40 people)belonged to parapatellar lateral approach group.The patients aged between 18 and 56. The mean and standard deviation were89 and 32±9, respectively. There were 70 males (87.5%) and 10 females (12.5%).Mean length of incisions was 6.61±0.66 mm. The prominence of nail fromthe anterior cortex was 5.5±1.63 mm. Knee range of motionin 56 (70%) of patients at2 weeks after surgery was less than 80 degree. Full knee range of motion in 29 (36%) patients at 6months after surgery was less than 90 degree. Intensity of knee pain according to VAS at2 weeks after surgerywas 6.77±8.26. Intensity of knee pain according to VAS at 6months after surgery was 1.47±1.14. Thigh muscle atrophyat2 weeks after surgeryfor73 (91.3%), 5 (6.3%), and 2 (2.5%) patients were equal to 0cm, 1cm and 2cm, respectively.Thigh muscle atrophyat 6months after surgery for 75 (93.8%), and 5 (6.3%)patients were equal to 0cm, and 1cm, respectively.

There was no significant difference between age, sex, type of fracture, length of incisions, protrusion of nail from the anterior cortex in the two group(P>0.05) (Table 1).However, there was a significant difference between knee range of motion at 2 weeks after surgery in the two group(P<0.05).
There was no significant difference between full knee range of motion at 6months after surgery for the two groups(P>0.05).The full knee range of motion at 6months after surgery in transpatellar group increased significantly (P<0.05).The full knee range of motion after 6monthsfrom surgery in lateral parapatellar group increased significantly(P<0.05) (Table 2).
There was a significant difference between intensity of knee pain at 2 weeks after surgery in the two group(P<0.05).There was a significant difference between intensity of knee pain at 6months after surgery in the two groups(P<0.05).The intensity of knee pain after 6monthsfrom insertion in transpatellar group decreased significantly (P<0.05).The intensity of knee pain after 6monthsfrom insertionof in lateral parapatellar group decreased significantly(P<0.05) (Table 2).
There was no significant difference between thigh muscle atrophy at 2 weeks after surgery in the two groups(P>0.05).There was no significant difference between thigh muscle atrophy at 6months after surgery in the two group(P>0.05).
The thigh muscle atrophy decreased after 6monthsfrom surgery in transpatellar group, but not significantly(P>0.05).The thigh muscle atrophy decreased after 6monthsfrom surgery in lateral parapatellar group, but not significantly(P>0.05) (Table 2).

Table 2.Comparison age, sex, type of fracture, Length of incisions, protrusion of nail from the anterior cortex in two group's transpatellar and lateral parapatellar approach

Type of plaque	group		P_Value
	Transpatellar	Parapatellar	
Age	31.5±10.59	32.5±9.24	0.446
Sex (male)	37 (92.5%)	33 (82.5%)	0.311
type of fracture Close Open	25 (62.5%) 15 (37.5%)	29 (72.5%) 11 (27.5%)	0.474
Length of incisions	6.62±0.74	6.6±0.59	0.66
protrusion of Nile from the anterior cortex	5.57±1.29	6.02±1.22	0.077

Table 3.Comparison knee range of motion, Intensity of knee pain and thigh muscle atrophyintwo group's transpatellar and lateral parapatellar approach

Type of plaques	Stage	group		P_Value
		Transpatellar	Parapatellar	
knee range of motion	2 week	66.53±8.89	71.37±12.6	0.04
	6month	87.75±2.98	88.12±3.13	0.46
Intensity of knee pain	2 week	6.97±0.83	6.6±0.77	0.03
	6month	1.83±1.25	1.22±1.02	0.023
thigh muscle atrophy	2 week	0.15±0.42	0.075±0.34	0.251
	6month	0.25±0.5	0.1±1.29	0.169

DISCUSSION

Our results revealed that there was no significant difference between background variables such as age, gender, fracture type, length of incision, and the protrusion of nail from the anterior cortex in the two groups. Therefore, the randomization process was well conducted and these items cannot be considered as confounding factors with regard to the differences between treatment outcomes of the two approaches and they cannot interfere with the results.
Based on our results, although after 2 weeks after nailing via parapatellar approach, full knee range of motion was significantly more than that of transpatellar group, this amount was the same after 6 months; however, full knee range of motion in both groups rose significantly within 6 months.. Sadeghpour *et al.* (2011), conversely, observed that the full knee range of motion within 2 weeks and 3 months after implementing the approach in both groups was the same.
The most important result of this study suggested that knee pain at 2 weeks and 6 months after nailing in the parapatellar group was significantly lower than that in the transpatellar group. However, the severity of knee pain in both groups significantly decreased 6 months after nailing.

This finding is in line with the results of many other studies, in which the rate of post-operative pain in patients with tibial shaft fractures who had undergone intramedullary nailing was lower in the parapatellar mode than in the transpatellar one [10, 13-15]. In a study, which is consistent with our study, Althausen *et al.* (2002) reported that pain in patients with the surgical approach of lateral parapatellar was less than that of the transpatellar method [34]. Similarly, in Sadeghpour's *et al*. (2011) study, it was indicated that pain intensity in both groups (parapatellar and transpatellar) fell off noticeably within 6 months. Moreover, the severity of knee pain at 2 weeks and 1 month after the surgery was the same in both groups, while at 3 and 6 months after nailing it was lower in the parapatellar group than in the other group [31].

In a study done by Väistö *et al*. [2008], whose results were different from this study, comparing patellar tendon method with transpatellar approach, prevalence of anterior knee pain did not decrease after intramedullary nailing of fractures of the tibial shaft. It seemed that, however, in the long term, anterior knee pain disappeared in most patients [18]. Also, Tahririan *et al.* [2014] concluded a study, in which the results were inconsistent with the current study. They proved that there was no significant correlation between the type of surgery (parapatellar and transpatellar) and anterior knee pain. However, it is likely that the risk of progression of knee pain after tibial nailing in patients with a protruded nail caused by the anterior knee cortex is high [32]. This inconsistency could be related to differences in the distribution of age, sex, race, type of fractures, size and type of the nail, as well as differences in how skillfully the nail is inserted, and finally differences related to patients' follow-up durations.

In both methods, i.e. parapatellar and transpatellar approaches, knee pain intensity reduced after 6 months. However, the etiology of anterior knee pain after intramedullary nailing of tibia or femur is not clear, though a combination of factors may lead to this phenomenon.Therefore, designing further studies to evaluate and identify factors affecting the anterior knee pain is recommended [31]. So far no definitive cause has been identified with regard to the higher intensity of knee pain in the transpatellar approach. the probability of further cartilage damage in transpatellar approach is higher than in the case of parapatellar approach [11].

The results of this study indicate that thigh muscle atrophy at 2 weeks and 6 months after nailing was similar in both groups. In other words, thigh muscle atrophy in both groups did not change a lot within 6 months after nailing. Based on the review literature, no studies have been conducted on patients with tibial shaft fractures that compare thigh muscle atrophy in the two approaches, something which has been examined in the present study. Consequently, it is not possible to compare this work with other studies.

The following are the limitations of this study:

First, this study was conducted for 6 months. Cohort study needs to be carried out, accordingly so that so that the evaluation of the impact of parapatellar and transpatellar on knee pain in the long term would be possible.

Second, the sample size in this study was small and the absence of significant differences in the variables of interest, especially thigh muscles atrophy, can be due to low sample size. Therefore, further studies with larger sample size is recommended.

Third, the knee pain symptom after surgery may be due to other factors than insertion site of the nail. So, more investigations are required in this regard and roll out other factor of knee pain.

Fourth, this study was conducted only in Ahvaz and due to variability of pain sensitivity in other people it may not be generalizable to other parts of the country.

CONCLUSION

The present study suggests that, after 6 months, knee pain intensity in intramedullary nailing of tibia shaft fractures is less in parapatellar mode than in transpatellar method. However, in terms of the range of motion of the knee and thigh muscles atrophy no significant difference was observed between two groups while intramedullary nailing of tibial shaft fractures. Hence, parapatellar method can be given priority. Eventually, it is proposed that further research with longer follow-up periods be devised in order to assess and compare long-term outcomes.

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