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Original Research

What Would be the Difference Between Operative Treatment of Patients with Tibia Fractures out of Working Hours; Intramedullary Nailing for Tibial Shaft Fractures

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Abstract

Objectives: Performing orthopedic surgery in and out of working hours may affect the success of the surgery. Timing of surgery in tibial shaft fractures is controversial. In this study, the effect of the timing of surgery on the success and complications of intramedullary nailing of tibial fractures is examined.

Methods: Archieves of patients with tibial shaft fractures treated with reamed intramedullary nails between 2010 and 2016 were retrospectively analyzed. Fifty-seven patients were included in the study. Patients were categorized by the time of the surgery. Day time (Group I) is between 7:00 am and 5:00 pm and after hour (Group II) is between 5:00 pm and 07:00 am. Group I (n: 40) and Group II (n: 17) were evaluated. Technical errors, surgery time, and length of hospital stay statistical analysis was performed between the two groups in terms of technical errors, complication rates, length of hospital stay, and duration of surgery.

Results: The mean duration of operation (p=0.419), number of distal screws (p=0.847), time to union (p=0.454), experience of the surgeon (p=0.192), and technical error rate (p=0.654) did not differ significantly between two groups. Length of hospital stay and time to surgery from emergency were significantly higher in day time group.

Conclusion: Technical errors and surgery time of intramedullary nailing of tibial shaft fractures are not higher at after hour before midnight than day time. Non-urgent tibial shaft fractures might be treated with intramedullary nailing at after hours before midnight for efficient use of hospitals.

Keywords: Intramedullary nailing, Tibial shaft fracture, Time of day, Time of surgery

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Intramedullary nailing is widely accepted treatment choice for tibial shaft fractures.[1-3] Timing of the surgery is controversial in the literature. Fractures which require emergent or urgent care are treated without regard for operation team's condition or time of the day. Some fractures do not require urgent care and surgeon decides the

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time of surgery. At after hours time fatigue of the surgeon, experience level and decreased availability of night time operating room staff are some of the reason for delayed operations. Controversially to prevent intensity of day time scheduled operations, some non-urgent fractures may be operated at after hours.

Time to surgical treatment is not a prognostic factor for functional outcomes of tibia fractures.[4-7] Ricci et al.[6] reported that femoral fractures which were treated at after hours need more re-operations than tibia fractures. Although the functional outcomes are similar for time of surgery; healing time, complications, operation times, and length of hospital stays are different.

The aim of this study is to evaluate the technical errors, operation times, complications, and length of hospital stay between closed intramedullary nailing for tibia shaft fractures at day time and after hours. In our study, we assumed that there would be higher rates of technical errors and complications in after hour cases.

Methods

After IRB approval (June 09, 2017/8) archieves of patients with tibia shaft fractures whom treated with reamed intramedullary tibial nail between 2010 and 2016 in our hospital were evaluated. The study was conducted in accordance with the Declaration of Helsinki. Patients with additional injury, pathological fracture, metabolic disease, previous treatment for this fracture (deterioration of reduction after conservative treatment and non-union), multitrauma patients, and neurovascular injuries were excluded from the study. The remaining 57 patients after exclusion were included in the study. Patients were categorized by the time of the surgery. Day time (Group I) is between 7:00 am and 5:00 pm and after hour (Group II) is between 5:00 pm and 07:00 am. Group I (n: 40) and Group II (n: 17) were evaluated. All tibia fractures are 42 for AO/OTA classification. Open fractures (n: 17) were classified according to Gustilo-Anderson Classification. Age, sex, comorbities, surgery time, length of hospital stay, time to surgery, experience of surgeons, number of distal locking screws, union time, ethiology (mechanism of injury), fracture type, concominant fibula fracture, and technical errors were evaluated.

Surgical Technique

The implants used in all patients were obtained from Tasarimmed®. The operations were performed with transpatellar approach in supine position under spinal anesthesia with fluoroscopy guidence. The nail that is in appropriate length and diameter for the bone was implanted intramedullary after the medulla was reamerized with flexible reamer. Proximal locking screws were implanted with an external guide. Distal locking screws were applied freehand under fluoroscopy.

Clinical Evaluation

Technical errors were described as improper proximal insertion point, fracture gap over 3 mm, tibial varus and valgus, protrusion at the knee, improper nail length and diameter, and iatrogenic fractures. Hernigou and Cohen[8] described the anatomical structures at risk and examined the most appropriate site of entry for tibial nailing (sweet spot). Proximal entry points which were far away about 5 mm from sweet spot at both anteroposterior and lateral radiographs were accepted as improper entry points. Tibial malalignment was sustained 5° or more angulation in any plane.[9] Intramedullary nail to canal diameter ratio <0.8 or >0.99 and distance between distal nail tip and ankle joint >5 mm were accepted as technical errors.[10] Radiological measurements were made from the post-operative radiographs through the pictures archives and communication systems program by an orthopedic surgeon who did not attend the operation.

Experience of the surgeon could affect the duration of the operation and technical errors.[11] In the present study, the operations performed by the same surgeons in day time and at after hours were included in the research to eliminate the experience difference between the surgeons. All surgeries were performed by ten orthopedic surgeons. Orthopedic surgeons are classified according to the experience years on the operation dates. Surgeons who have worked for 5 years as an orthopedic surgeon were classified as experienced and others inexperienced.

The operating team is left without radiology technicians for fluoroscopy at after hours. Fluoroscopy is used by operating room staff at after hours. All operating room nurses have orthopedic surgery experience at after hours and day time without any distinction.

Statistical Analysis

The data were analyzed using IBM SPSS version 22.0 (IBM Corporation, New York, USA). Mean, standard deviation, median, frequency, and ratio values are used in the descriptive statistics of the data. The distribution of the variables was measured by the Kolmogorov–Simirnov test. Independent sample t-test and Mann-Whitney U-test were used in the analysis of quantitative independent data. Chi-square test was used to analyze qualitative independent data, and Fischer test was used when Chi-square test conditions were not met.

Results

Seventeen patients were operated at after hours and 40 patients were operated at day time. Descriptive characteristics of the patients are shown in Table 1. The length of hospital stay and the mean time to operation day in day time group were significantly higher than after hour group (Table 2). The mean duration of operation, number of distal screws, time to union, experience of the surgeon, type of fracture, and technical error rate did not differ significantly (p>0.05) (Tables 2 and 3).

Table 1. Descriptive characteristics of the patients

	Min-Max	Median	Mean±SD/n-%
Age	16–66	29.0	32.8±12.5
Sex			
Female			18±31.6
Male			39±68.4
Length of hospital stay (day)	1–14	4.0	4.8±2.7
Time to surgery from E.R. (minute)	187–11751	2466	3069±2928
Surgery time (minute)	40–200	90.0	91.1±34.4
Number of distal locking screws	1–4	2.0	2.0±0.6
Time to union	44–269	88.0	93.6±36.5
Experience of surgeon			
<5 years			31±54.4
≥5 years			26±45.6
Etiology			
Non-motor vehicle accident		2±3.5	
Gunshot			1±1.8
Horse kick			1±1.8
Assault			1±1.8
Fall		37±64.9	
Sports accident			2±3.5
Motor vehicle accident			13±22.8
Fracture classification AO/OTA			
42A1			29±50.9
42A2			10±17.5
42A3			14±24.6
42B2			2±3.5
42C1			2±3.5
Open fracture type gustilo-anderson			
Closed			40±70.2
Open			17±29.8
I			9±15.8
II			5±8.8
III			3±5.3
Concomitant fibula fracture			
Yes		50±87.7	
No		7±12.3	
Fracture segment			
Distal			26±45.6
Middle			28±49.1
Proximal			3±5.3
Technical errors			
Yes		21±36.8	
No		36±63.2	

Table 2. Comparison of clinical features between groups in patients

	Day time		After hours		P
	Mean±SD/n-%	Median	Mean±SD./n-%	Median	
Age	31.5±12.8	29.0	35.6±11.9	34.0	0.260[t]
Sex					
Woman	12±30.0		6±35.3		0.694[X²]
Man	28±70.0		11±64.7		
Length of hospital stay (day)	5.5±2.8	5.0	3.1±1.7	3.0	0.001[m]
Time to surgery from E.R. (min.)	4162±2860	3507	499±277	428	0.001[m]
Surgery time (minute)	93.6±37.7	90.0	85.4±24.8	90.0	0.419[t]
Number of distal locking screws	2.0±0.6	2.0	2.1±0.7	2.0	0.847[t]
Time to union (day)	95.9±40.9	88.0	87.5±20.5	92.0	0.454[t]
<5 years	24±60.0		7±41.2		0.192[X²]
Experience of surgeon					
≥5 years	16±40.0		10±58.8		
Open Fr type gustilo A					
Close	31±77.5		9±52.9		0.064[X²]
Open	9±22.5		8±47.1		
I	5±12.5		4±23.5		
II	3±7.5		2±11.8		
III	1±2.5		2±11.8		
Concomitant Fibula Fr.					
Yes	36±90.0		14±82.4		0.421[X²]
No	4±10.0		3±17.6		
Fracture segment					
Distal	17±42.5		9±52.9		0.664[X²]
Middle	21±52.5		7±41.2		0.622[X²]
Proximal	2±5.0		1±5.9		1.0[X²]
Technical errors					
None	26±65.0		10±58.8		0.654
Yes	14±35.0		7±41.2		

[t]t test/[m] Mann–Whitney U-test/[X²] Chi-square test.

Discussion

The striking findings of the present study are that the length of hospital stay and the time to operation were found to be significantly increased in the management of tibia shaft fractures by reamerized nailing between day time and after hours. The amount of technical error and complication rates were not found to be significantly different between two groups on the contrary to our expectation. On the other hand, all the after hour operations were performed before midnight. These findings could have arised as a result of this condition.

The mean length of hospital stay is significantly higher in day time group. This difference is not about complications. The time to operation from emergency room is also significantly higher. Due to scheduled operations and lack of available orthopedic trauma operating room at day time, fractures which cannot be operated or are not operated at after time are waitlisted. Delays in surgery and lengthening of hospital stay cause the raised expenses to healthcare system.[4] In this study, the additional expenses on healthcare system was not investigated; however, we reckon the increased duration of hospital stay gives rise to additional unnecessary expenses on the health-care system; furthermore, the waitlisting of these patients hinders the efficient use of hospitals.

Night time surgery was not found to be associated with a higher rate of complications in some studies.[12-14] Even higher incidence of complications was not observed, Aydogmus et al.[13] reported that poor fixation rate of distal humerus fractures was significantly greater in the after hours group. None of these researches evaluated the fatigue of the surgeon directly. Brandenberger et al.[15] evaluated the cognitive functions of the surgeons after

Table 3. Etiological and AO/OTA classification of patients

	Day Time		After hours		P
	Mean±SD./n-%	Median	Mean±SD./n-%	Median	
Etiology					
Non-motor vehicle accident	0±0.0		2±11.8		
Gunshot	1±2.5		0±0.0		
Horse kick	0±0.0		1±5.9		
Assault	1±2.5		0±0.0		
Fall	27±67.5		10±58.8		
Sports accident	1±2.5		1±5.9		
Motor vehicle accident	10±25.0		3±17.6		
Fracture classification AO/OTA					
42A1	19±47.5		10±58.8		
42A2	9±22.5		1±5.9		
42A3	9±22.5		5±29.4		
42B2	2±5.0		0±0.0		
42C1	1±2.5		1±5.9		

night-shift and day-shift. They reported that the night-shift group was found significantly less proficient in cognitive tasks after their shifts. Some studies also suggested that errors could occur due to fatigue of the surgeons.[6,16,17] In this study, it is revealed that at what time, the operation was performed which does not have an impact on complication rates.

Mckee et al.[18] looked for the answer to the question of which operations could be postponed until the following day in orthopedics. They reported that surgical treatment of uncomplicated fractures of tibia and fibula with no displacement is inappropriate after midnight. Yaghoubian et al.[19] described night time between 10 PM and 6 AM to compare outcomes of trauma surgery performed by residents who have worked longer than 16 h. They reported similar favorable outcomes for both groups. Timing of tibia shaft fracture nailing surgery may not be of significant importance. On the other hand, all the after hour operations were performed before midnight. This could be interpreted as there is no significant difference between day time and after hours before midnight.

Proximal insertion point of the tibial nail is important for minimalizing the damage of joint cartilage and the anatomical structures at risk. Hernigou and Cohen[8] described the most appropriate site of entry for tibial nailing ("sweet spot"). Technical error was defined as having an entry point other than the sweet spot. In retrospective review of 30 patients, eight entry points were found out of the sweet spot.[8] There were two improper insertion points for after-hours and six for day-time in our groups. This ratio is proportional to the literature.

Fracture gap after surgery in tibial shaft fractures is also important for union. Study to prospectively evaluate reamed intramedullary nails in patients with tibial fractures (SPRINT) investigators reported that post-operative fracture gap even <1 cm had increased risk.[20] In this study, more than 3 mm post-operative fracture gap was accepted as a technical error. This technical error was found two patients in day-time group and one patient in after-hours group. In this study, there were no patients with fracture gap >1 cm and non-union.

The limitations of this study could be listed as having low number of cases, being a retrospective study, operations not having been performed by a single surgeon, being single-centered, after hours team being familiar with the orthopedic operations since the center is a orthopedics hospital. One of the major limitations of this study is that all after hour operations were performed before midnight. This condition might have resulted with the statistical indifference between day time and after hours. On the other hand, it could be concluded that technical errors are not affected from whether the operation was performed in day time or at after hours for operations performed before midnight. These limitations could be mended with prospective randomized controlled trials which are multi-centered, have more cases, comparison of results from different surgeons, and where operation time is also considered.

Conclusion

There are no differences in terms of complication rates and technical errors between the operations performed in day time and after hours before midnight. Moreover, the

length of hospital stay was found to be longer in the day time group. For this reason, tibia shaft fractures could be safely operated before midnight by intramedullary nailing.

Disclosures

Ethics Committee Approval: Consent of Ethics was obtained from Ethic Committe (09.06.2017/8).

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Conflict of Interest: None declared.

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