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RADIOLOGICAL UNION IN SUBJECTS WITH PROXIMAL TIBIAL FRACTURES MANAGED WITH COLUMN-SPECIFIC FIXATION

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ABSTRACT

Background: Strong varus or valgus forces combined with axial loading are typically the cause of upper tibia fractures. The femoral condyle applies compressive and shearing stresses to the tibia's articular surfaces in people who experience valgus or varus forces with the axial load, resulting in proximal fracture.

Aim: The present study assessed the radiological union in subjects with proximal tibial fractures managed with column-specific fixation at an Indian healthcare center.

Methods: Sixty patients with proximal tibial fractures treated with column-specific fixation were evaluated in this study. KSS was measured in all individuals, including the knee and functional subgroups, at the nine-month follow-up. Excellent, good, fair, and poor knee society scores were 80 to 100, 70-79, 60-69, and less than 60. A statistical analysis was performed on the collected data.

Results: The study's findings demonstrated that the posterior column fixation range of motion was evaluated individually rather than in groups. The completed group's mean was 130±22, while the unfinished group's mean was 129.52±10.503. With a p-value of 0.75, the difference between the two groups was not statistically significant.

Conclusions: The current study comes to the conclusion that column-specific fixation procedures are useful in multiplanar fractures involving the posterior column and aid in the restoration of articular congruity, rigid fixation, and appropriate anatomical reduction. In comparison to the non-fixation group, the posterior column fixation group has better radiological union.

Keywords: radiographic union, proximal tibial fracture, tibia fracture, and column-specific fixation

INTRODUCTION

The stresses that are typically applied to human knee joints are over five times more than the body weight. Knee joints can rotate between 8 and 12 degrees and flex between 10 and 140 degrees. Lateral and medial condyles are formed when the proximal tibia expands from the shaft.1 The articular surface of the tibial condyle that articulates with the femoral condyles is known as the tibial plateau. The tibial plateau exhibits an anteroposterior slope between 7° and 10°. This procedure hinders the insertion of the anterior cruciate ligament and displays translation. Articular cartilage does not cover the most posterior part of the interspinous area.2 Strong varus or valgus forces combined with axial stress are typically the cause of upper tibia fractures.

The femur's corresponding condyle applies compression and shearing stresses to the tibia's articular surface when a person experiences valgus or varus force in addition to the axial load. Split fractures, depressed fractures, or both typically result from this. Adult patients with dense cancellous bone that can withstand compressive stresses on the joint surface are typically the only ones with isolated split fractures. The robust cancellous bone of the proximal tibia gradually becomes sparser with age and loses its ability to absorb compressive stresses. A split depressed or depressed fracture is observed with impact loading.3

When valgus stresses push the lateral femoral condyle to the tibial plateau, the medial collateral ligament acts as a hinge. Medial plateau fractures are caused by the lateral collateral ligament, which functions similarly to varus forces. Ligament injuries are more common in patients with upper tibial fractures when using magnetic resonance imaging (MRI). Therefore, in cases of lateral plateau fracture, anterior cruciate ligament injury or medial collateral ligament injury may accompany the fracture. However, fractures of the medial tibial plateau may be associated with tears in the cruciate ligament or lateral collateral ligament.4,5

The degree of knee flexion or extension significantly determines the site of the fracture. However, explosive highly comminuted fractures are observed when the axial stress exceeds 8000 pounds. Clinical cases of extended knees and falls from heights are thought to exhibit this mechanism.Six The goal of the current study was to evaluate the radiographic union in patients at an Indian medical facility who had proximal tibial fractures treated with column-specific fixation.

MATERIALS AND METHODS

In order to evaluate the radiological union in patients with proximal tibial fractures treated with column-specific fixation at an Indian medical facility, the current prospective clinical study was conducted. The Institute's Department of Orthopedics provided the study participants. Prior to their involvement in the study, all participants provided written and verbal informed consent.

The study evaluated sixty adult participants of both sexes who were hospitalized to the Institute's Department of Orthopedics and had a proximal tibial fracture, with or without additional injuries.

The inclusion criteria for the study were subjects from both genders, in the age range of 18-60 years, fracture of tibial plateau classified following the three-column concept of Luo et al in 2010[7,] and subjects that were willing to participate in the study. The exclusion criteria for the study were subjects not willing for the surgery, subjects who did not give consent for study participation, foot, ankle, tibial shaft, or ipsilateral femur fractures, open tibial plateau fracture, and skeletally immature individuals.

After the final inclusion of the study subjects based on the inclusion criteria, detailed history was taken for all the study subjects followed by comprehensive clinical examination, knee aspiration, knee X-ray in lateral and AP view, CT knee with 3D reconstruction, and hematological assessment for viral markers, serum creatinine, urea, blood sugar, and hemoglobin. Intravenous blood was drawn under rigorous aseptic and sterile conditions for laboratory tests.

The valgus angle between the anatomic axes of the tibial and femoral shafts was used to evaluate fracture alignment in the coronal plane. After the KSS (knee society score) of 67, the normal valgus angle was determined to be between 5 and 10 degrees. Angulation between the anterior cortices of the proximal and distal fragments was used to measure sagittal plane alignment. It is considered normal when the sagittal plane is angled within five degrees of the opposing side. Subjects were monitored every six weeks until the bony union was seen at the articular and metaphyseal fracture sites. After that, they were monitored every three months for nine months.

KSS, comprising the function and knee subgroups, is documented at the nine-month follow-up. Knee society scores of 80 to 100, 70-79, 60-69, and less than 60 were considered outstanding, acceptable, fair, and bad, respectively. Fracture union, callus development, and progression were evaluated for radiological results.Every recall involved the taking of lateral and anteroposterior radiographs of the proximaltibia with the knee.A nine-month radiograph was examined for signs of secondary osteoarthritis, such as joint space narrowing.

Using SPSS (Statistical Package for the Social Sciences) software version 21.0 (IBM Corp., Armonk, NY, USA), the collected data was statistically analyzed using the chi-square test, independent t-test, Mann Whitney U test, and assessment of descriptive measures. The mean, standard deviation, frequency, and percentages were used to express the results. A p-value of less than 0.05 was deemed statistically significant.

RESULTS

In order to evaluate the radiological union in patients with proximal tibial fractures treated with column-specific fixation at an Indian medical facility, the current prospective clinical study was conducted. In this study, 60 patients with proximal tibial fractures treated with column-specific fixation were evaluated. At six weeks, three months, six months, and nine months, respectively, the modified Rasmussen scores were 9.95±1.157, 12.22±1.184, 13.62±1.161, and 13.90±1.192, indicating a substantial rise with time (p=0.001). At six weeks, three months, six months, and nine months, KSS was not significant between the done and not done groups for functional outcomes in participants with and without posterior column fixation at various time intervals (p=0.682, 0.783, 0.905, and 0.562, respectively) (Table 2).

For radiological outcomes, patients with and without posterior column fixation at different time intervals of six weeks and three months showed similar non-significant results (p=0.184 and 0.252, respectively). However, at 6 and 9 months, the done group had a significantly higher KSS (p=0.01 and 0.04, respectively) (Table 3).

In terms of radiological and functional results, 2, 32, and 14 participants in the posterior column fixation group had 1 column, 2 columns, and 3 columns, while 2, 4, and 6 subjects had posterior column fixation.

The KSS scores were 190, 190, and 164 with a mean movement range of 140, 140, and 130, and the Modified Rasmussen score (AVG) was 32, 30, and 28 in 1-column, 2-column, and 3-column, respectively (Table 4). AVG modified Rasmussen scores were 13.62 and 12.64, KSS was 93.3 and 83.1, and mean movement range was 130 and 122.3, respectively. In the non-fixation group, posterior column involvement was observed in 32 and 14 subjects in 2-column and 3-column, while posterior column fixation was observed in 28 and 8 subjects (Table 5).

The mean and standard deviation of the posterior column fixation done and not done groups in the current study were 130±20 and 129.52±10.503, respectively, indicating a statistically non-significant difference with p=0.73.

After fixation, no research participant had a full weight-bearing evaluation at six weeks, 42.9% (n=26) at three months, and 100% (n=60) at six months (Table 6). Union times for proximal tibia fractures were seen in study participants at varying intervals; in one column, union times for 0, 12, and 12 patients were 6 weeks, 3 months, and 6 months, respectively. Union times for subjects 0, 32, and 34 were 6 weeks, 3 months, and 6 months in two columns. Union times for subjects 0, 6, and 14 were 6 weeks, 3 months, and 6 months, respectively, in three columns (Table 7).

According to the study's findings, 16.66% (n = 10), 13.33% (n = 8), and 70% (n = 42) of the participants had steps of 1 mm, 2 mm, and nil, respectively. In 52.5% (n=36), 16.5% (n=10), and 23.1% (n=14) of the patients, respectively, there was no varus/valgus angulation, valgus angulation, and varus angulation (Table 8).

Varus and valgus malunion were observed in 2, 6, and 0 patients from 1 column, 2 columns, and 3 columns, respectively, with varus angles greater than 3 degrees. 0, 8, and 6 patients from 1 column, 2 column, and 3 column, respectively, had varus malunion. Four, two, and four individuals from one column, two columns, and three columns, respectively, had valgus malunion. Ten participants had valgus malunion and fourteen had varus malunion (Table 9).

According to Table 10, 3.3% (n=2), 6.7% (n=4), 46.7% (n=28), 6.7% (n=4), 6.7% (n=4), 10% (n=6), 13.3% (n=8), and 6.7% (n=4) of research participants had posterior tilts of 5, 7, 8, 9, 10, 11, 12, and 14 degrees, respectively.

DISCUSSION

In this study, 60 patients with proximal tibial fractures treated with column-specific fixation were evaluated. At six weeks, three months, six months, and nine months, respectively, the modified Rasmussen scores were 9.95±1.157, 12.22±1.184, 13.62±1.161, and 13.90±1.192, indicating a substantial rise with time (p=0.001). At six weeks, three months, six months, and nine months, KSS was not significant between the done and not done groups for functional outcomes in subjects with and without posterior column fixation at various time intervals (p=0.682, 0.783, 0.905, and 0.562, respectively). For radiological outcomes, patients with and without posterior column fixation at different time intervals of six weeks and three months showed similar non-significant results (p=0.184 and 0.252, respectively).

At 6 and 9 months, however, the done group had a significantly higher KSS (p=0.01 and 0.04, respectively). These findings were comparable to those of regarding radiological and functional results, the posterior column fixation group showed 1 column, 2 columns, and 3 columns in 2, 32, and 14 participants, respectively, while posterior column fixation was performed in 2, 4, and 6 subjects. The KSS scores were 190, 190, and 164 with a mean movement range of 140, 140, and 130, while the Modified Rasmussen score (AVG) was 32, 30, and 28 in 1, 2, and 3 columns, respectively.

The non-fixation group showed posterior column involvement in 32 and 14 patients in 2-column and 3-column, posterior column fixation in 28 and 8 subjects, AVG modified Rasmussen scores of 13.62 and 12.64, KSS of 93.3 and 83.1, and mean movement range of 130 and 122.3, respectively. According to the study's findings, the posterior column fixation done and not done groups' range of motions was 130±20 and 129.52±10.503, respectively, indicating a statistically non-significant difference with p=0.73. After fixation, no research participant had a full weight-bearing evaluation at six weeks, 42.9% (n=26) at three months, and 100% (n=60) at six months.

Union times for proximal tibia fractures were seen in study participants at varying intervals; in one column, union times for 0, 12, and 12 patients were 6 weeks, 3 months, and 6 months, respectively. Union times for subjects 0, 32, and 34 were 6 weeks, 3 months, and 6 months in two columns. Union times for subjects 0, 6, and 14 were, respectively, 6 weeks, 3 months, and 6 months. According to the study's findings, 16.66% (n=10), 13.33% (n=8), and 70% (n=42) of the participants had steps of 1mm, 2mm, and zero, respectively. In 52.5% (n=36), 16.5% (n=10), and 23.1% (n=14) of the patients, there was no varus/valgus angulation, valgus angulation, and varus angulation, respectively.

These conclusions were consistent with the outcomes of regarding varus and valgus malunion in the research participants, 2, 6, and 0 subjects from 1 column, 2 columns, and 3 columns, respectively, had varus angles more than 3 degrees. 0, 8, and 6 individuals from +1 column, 2 column, and 3 column, respectively, had varus malunion.Four, two, and four individuals from columns one, two, and three, respectively, had valgus malunion. Ten participants had valgus malunion and fourteen had varus malunion (Table 9). 3.3% (n=2), 6.7% (n=4), 46.7% (n=28), 6.7% (n=4), 10% (n=6), 13.3% (n=8), and 6.7% (n=4) of the study individuals had posterior tilt of 5, 7, 8, 9, 10, 11, 12, and 14 degrees, respectively.

These data correlated with the findings of

CONCLUSIONS

Within its limitations, the current study shows that column-specific fixation procedures are useful in multiplanar fractures affecting the posterior column and assist restore articular congruity and rigid fixation by providing appropriate anatomical reduction. In comparison to the non-fixation group, the posterior column fixation group has better radiological union. To draw a firm conclusion, more long-term research is necessary.

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S. No	Modified Rasmussen score (MRS)	Mean ± S. D	p-value
1.	6 weeks	9.95±1.157	**0.001**
2.	3 months	12.22±1.184	
3.	6 months	13.62±1.161	
4.	9 months	13.90±1.192	

Table 1: Modified Rasmussen scores at different time intervals

Posterior column fixation	6 weeks KSS		3 months KSS		6 months KSS		9 months KSS	
	Done	Not done	Done	Not done	Done	Not done	Done	Not done
Number (n)	12	40	12	40	12	40	12	40
Mean ± S. D	63.15 ±11.17	64.50 ±5.143	74.02 ±11.813	73.08 ±4.943	79.52 ±12.706	79.92 ±4.951	88.52 ±10.481	86.72 ±5.123
p-value	0.682		0.783		0.905		0.562	

Table 2: Functional outcomes in subjects with and without posterior column fixation at different time intervals

Posterior column fixation	6 weeks KSS		3 months KSS		6 months KSS		9 months KSS	
	Done	Not done	Done	Not done	Done	Not done	Done	Not done
Number	12	40	12	40	12	40	12	40
Mean ± S. D	10.52 ±1.641	9.82 ±0.892	12.65 ±1.504	12.03 ±0.997	14.65 ±1.031	13.33 ±1.042	14.65 ±1.031	13.63 ±1.042
p-value	0.184		0.252		**0.01**		**0.04**	

Table 3: Radiological outcomes in subjects with and without posterior column fixation at different time intervals

S. No	Three column classification	Posterior column involvement	Posterior column fixation (n)	Modified Rasmussen score (AVG)	KSS	Mean movement range
1.	**1 column**	2	2	32	190	140
2.	**2 column**	32	4	30	190	140
3.	**3 column**	14	6	28	164	130

Table 4: Radiological and functional outcomes in the posterior column fixation group

S. No	Three column classification	Posterior column involvement	Posterior column fixation (n)	Modified Rasmussen score (AVG)	KSS	Mean movement range
1.	**2 column**	32	28	13.62	93.3	130
2.	**3 column**	14	8	12.64	83.1	122.3

Table 5: Radiological and functional outcomes in the posterior column non-fixation group

S. No	Full weight-bearing ambulation	Frequency (n)	Percentage (%)
1.	**6 weeks**	Nil	Nil
2.	**3 months**	26	42.9
3.	**6 months**	60	100

Table 6: Full weight-bearing assessment in study subjects following fixation

S. No	Classification	Union time		
		6 weeks	3 months	6 months
1.	1 column	0	12	12
2.	2 column	0	32	34
3.	3 column	0	6	14

Table 7: Union time for proximal tibia fracture in study subjects at different time intervals

S. No	Step (mm)			Varus/valgus		
		Number (n)	Percentage (%)		Number (n)	Percentage (%)
1.	1mm	10	16.66	None	36	52.5
2.	2mm	8	13.33	Valgus	10	16.5
3.	Nil	42	70	Varus	14	23.1
4.	Total	60	100	Total	60	100

Table 8: Post-union assessment of study subjects

S. No	Classification	Varus		Valgus
		<3 degrees	Varus malunion	Valgus malunion
1.	1 column	2	0	4
2.	2 column	6	8	2
3.	3 column	0	6	4
4.	Total	8	14	10

Table 9: Assessment of valgus and varus malunion in study subjects

S. No	Post union assessment Posterior tilt (degrees)	Frequency (n)	Percentage (%)
1.	5	2	3.3
2.	7	4	6.7
3.	8	28	46.7
4.	9	4	6.7
5.	10	4	6.7
6.	11	6	10
7.	12	8	13.3
8.	14	4	6.7
9.	Total	60	100

Table 10: Posterior tilt assessment in study subjects