RESEARCH ARTICLE

Frequency of osteoarthritis and functional outcome of operated tibial plateau fractures: A minimum of 5 years follow up

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Abstract

Objective: Tibial plateau is an important weight bearing surface and its fractures are the result of axial compressive forces. Post-traumatic osteoarthritis (PTOA) occurs despite anatomical joint reconstruction. In this study we determined the incidence of PTOA after primary management of tibial plateau fractures and determined the risk factors of PTOA of patients whose results were published at 24 months and now we present a five year follow up of the same patients.

Methods: In this study, we presented the prospective data of 109 patients who were managed for tibial plateau fractures, from August 2009 to June 2018 a Jinnah postgraduate medical centre. Data of patients regarding clinical and radiological, functional outcome (according to the American Knee Society criteria), post-procedural visual analogue scale (VAS) pain score was included. Incidence of development of PTOA was noted in each patient using the Ahlbäck classification.

Result: Out of 109 patients with tibial plateau fractures, 81 (74.3%) were male and 28 (25.7%) were female. Mean time lag from injury to surgery was 10.14±9.07 days. Overall incidence of osteoarthritis was 50 (45.9%). Advanced age >50 years (odds ratio 9.1 (3.7-22.1), p-value <0.0001), female gender (odds ratio; 3.40 (1.36-8.46), p-value 0.007), VAS score ≥4 ((odds ratio; 73.28 (15.7-341.5), p-value <0.001)), Articular depression (odds ratio; 35.25 (11.49-108.1), p-value <0.001) and degree of mal-alignment (odds ratio; 25.72 (9.30-71.12), p-value <0.001) were found to be the risk factors of PTOA. While excellent functional outcomes were protective for PTOA (odds ratio; 4.8, p-value <0.001). Thirty out of fifty patients (60%) suffering from secondary arthritis of the knee required knee replacement (TKR). Twenty-one patients (70%) were males that underwent TKR.

Conclusion: There is a high proportion of osteoarthritis following tibial plateau fixation. The risk factors that related to the development of secondary arthritis our cohorts were increased age, male gender, a decrease in AKSS and a higher VAS group. Knee arthroplasty is the only option for our cohorts with severe posttraumatic arthritis.

Keywords: Osteoarthritis, tibial plateau fractures, American Knee Society and visual analogue scale.

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Introduction

Bicondylar fractures of the proximal tibia (Schatzker V and VI) occur as a result of axial loading together with varus/valgus applied forces, which leads to articular depression and malalignment.[1,2] In the absence of a unified treatment protocol for tibial plateau fractures, these fractures represent with a broad spectrum of severity ranging from simple injuries with predictably excellent outcome after nonoperative treatment to complex fracture patterns that challenges even most experienced surgeons.[3-5] Moreover, surgical management of these high-velocity fractures can be demanding and are prone to intra operative challenges of maintaining reduction, alignment and stability.[6]

As the knee is a weight-bearing joint, the anatomical reduction is pivotal for the restoration of the mechanical axis. Therefore, the presence of residual incongruity could lead to joint stiffness and is a known contributing risk factor for posttraumatic osteoarthritis (PTOA).[7,8]

There is variable evidence of secondary arthritis present in the literature, around 25% to 45% of patients with fractures of the tibial plateau having a radiological evidence of PTOA at long term follow up.[1,5,9-12]

The development of arthritis is related to the following factors; increased age (increased chances of osteoporosis), the complexity of the fracture, lower limb malalignment, mechanics of fracture, early range of motion for cartilage nourishment and preservation have a significant impact on the overall prognosis and development of osteoarthritis.[1,11,12]

Osteoarthritis leads to pain, swelling, stiffness, muscle weakness and joint instability, all of which can result in impairment of physical function, a decline of life quality and may have significant socio-economic influence. Total knee replacement (TKR) remains the only viable option in

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severe cases of secondary arthritis of the knee. TKR allows a painless joint, restoration of the alignment and provides mobility to the patient.

Since there are no studies published at national level that describe the incidence of PTOA following tibial plateau fractures, the primary aims of this study were to assess the functional outcome in terms of the American knee society score (AKSS) and Visual Analogue Scale (VAS) and to evaluate the frequency of PTOA after surgical management of proximal tibia fractures after a minimum of five years follow up. While the secondary aim was to assess the frequency of patients undergoing TKR secondary to PTOA following plateau fractures.

Methods

Following the permission of ethics review committee of the hospital, a prospective study was conducted in the Department of Trauma & Orthopaedic Surgery, Jinnah Postgraduate Medical Centre, Karachi from August 2009 to June 2018.

Inpatient records of all patients 18 years and above treated for Schatzker type V and VI managed by two different modalities dual plating and Ilizarov between 2009 and 2014 were traced from the medical record department and included in the study. Patients with pathological fractures, floating knee, severe head injury, polytrauma and significant comorbidities like congestive heart failure, hypertension, chronic liver disease, stroke or obstructive lung disease were excluded from the study. Also, patients having a follow-up of fewer than five years were excluded from the study protocol (Figure-1).[13]

After finding the records of bicondylar tibial plateau fractures that were operated between august 2009 and June 2014 patients were contacted and 109/137 came to fracture clinic and their patient reported outcomes were recorded.

Preoperative data, including demographic data, mode of injury, the time lag between injury and primary surgery and fracture classification, according to Schatzker, was collected. Radiographic findings, including the fracture pattern, displacement of fragments, and depression of fragments were also noted. Preoperative computed tomography (CT) scan findings, intraoperative findings, and data regarding the course in the hospital were collected from the inpatient records.

After discharge from the hospital, the patients had been followed up in the outpatient clinic, and functional outcome was assessed using the American Knee Society criteria and development of osteoarthritis using the Ahlbäck classification. The pain was assessed using the visual analogue scale (VAS) and patients who underwent total knee replacement was noted.

Data were analysed using SPSS Version 20. Mean, and the standard deviation was calculated for quantitative data. Frequency and percentages were calculated for qualitative variables. Univariate/multivariate analysis was performed to determine the baseline and surgical risk factors of PTOA after primary treatment and odds ratio was calculated. Level of significance was taken as 0.05.

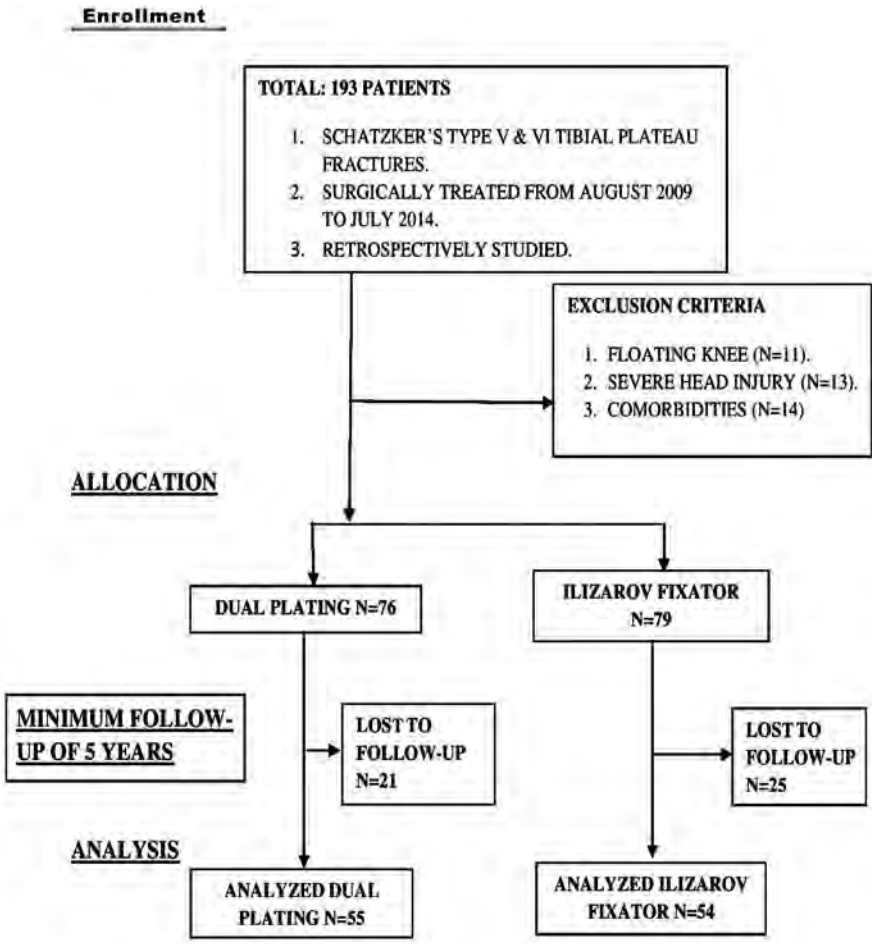

Figure-1: Consort diagram.

Results

A total of 109 patients with tibial plateau fractures who met the eligibility criteria were enrolled in the study. The mean age of the study population was 50.80±10.16 years with a male predominance of 74.3% (81). Mechanism of injury distribution showed that 76 (69.7%) had a road traffic accident, 20 (18.3%) had fallen from a height, and 13 (11.9%) had gunshot injury. According to the fracture pattern, Schatzker Type VI were 61 (56%) cases, whereas type V fractures accounted for 48 (44%) cases in the study population, respectively (Table-1).

Out of 109, 55 (50.5%) patients were managed by dual plating, and 54 (49.5%) patients underwent Ilizarov. The mean time lag between injury and primary surgery was10.14±9.07 days, and time to weight-bearing was 24.23±8.60 days, respectively. Functional outcome according to the AKSS was excellent (80-100) in 17 (15.6%), good (70-79) in 35 (32.1%), whereas 24 (22%) had a fair (60-69) outcome and 33 (30.3%) were rated as poor (less than60) results. Out of the total 109 patients, 50 (45.9%) patients developed PTOA with a mean follow up of 73.21±10.19 months. Thirty out of fifty patients (60%) suffering from secondary arthritis of the knee required knee replacement out of which 66.7% were of age >50 years. Twenty-one (70%) patients were males that

Table-1: Data of baseline variables.

Patient Characteristics		Value	
Age			
Age group	15-50 Years	51	46.8%
	>50 Years	58	53.2%
Gender	Male	81	74.3%
	Female	28	25.7%
Mechanism of injury	RTA	76	69.7%
	Fall	20	18.3%
	Gunshot	13	11.9%
Schatzker type	V	48	44%
	VI	61	56%

RTA: Road Traffic Accident

Table-2a: Data of study related variables.

Patient Characteristics		Value	
Mean duration between injury and primary surgery (days)		9.07	
Type of surgery	Plating	55	50.5%
	Ilizarov	54	49.5%
American knee society score	Excellent	17	15.6%
	Good	35	32.1%
	Fair	24	22%
	Poor	33	30.3%
VAS Score	I-III	71	65.1%
	IV-V	38	34.9%
Mean time to walking without aid (weeks)	24.45	8.60	
Mean time to follow-up (months)	73.21	10.19	
Osteoarthritis	Yes	50	45.9%
	No	59	54.1%
Total knee replacement	Yes	30	27.5%
	No	79	72.5%

Table-2b: Risk factors of post-operative osteoarthritis.

		Osteoarthritis		Relative Risk	P-value
		Yes (50)	No (59)		
Age	≤50 Years	10 (19.6%)	41 (80.4%)	18.49	<0.001
	>50 Years	40 (69%)	18 (31.0%)		
Gender	Male	31 (38.3%)	50 (61.7%)	0.56	0.006
	Female	19 (67.9%)	9 (32.1%)		
Schatzker type	V	21 (43.8%)	27 (56.3%)	0.92	0.69
	VI	29 (47.5%)	32 (52.5%)		
Type of Injury	RTA/Fall	42 (43.8%)	54 (56.3%)	8.57	0.17
	Gunshot	08 (61.5%)	05 (38.5%)		
Type of Surgery	Dual plating	21 (38.2%)	34 (61.8%)	0.71	0.12
	Ilizarov	29 (53.7%)	25 (46.3%)		
American knee society score	Excellent	0 (0.0%)	17 (100%)	-4.8	<0.001
	Good	4 (11.4%)	31 (88.6%)	3.54	
	Fair	13 (54.2%)	11 (45.8%)	3.87	
	Poor	33 (100%)	0 (0.0%)	2.80	
VAS Score after Surgery	I-III	14 (19.7%)	57 (80.3%)	0.21	<0.001
	≥IV	36 (94.7%)	2 (5.3%)		
Articular Depression	0-2 mm	05 (9.6%)	47 (90.4%)	0.12	<0.001
	3-7 mm	45 (78.9%)	12 (21.1%)		
Degree of Mal-alignment	0-4	08 (14.0%)	49 (86.0%)	0.17	<0.001
	≥5°	42 (80.8%)	10 (19.2%)		

VAS: Visual Analogue Score

underwent TKR (Table-2a).

On univariate/multi-variate analysis, advanced age >50 years (odds ratio 9.1 (3.7-22.1), p-value <0.0001), female gender (odds ratio; 3.40 (1.36-8.46), p-value 0.007) were found to be the risk factors of posttraumatic osteoarthritis (PTOA). While excellent functional outcomes according to AKSS were protective for PTOA (odds ratio; -4.8, p-value <0.001). VAS score more than IV was also found to be significant factor of PTOA (odds ratio; 73.28 (15.7-341.5), p-value <0.001). Articular depression (odds ratio; 35.25 (11.49-108.1), p-value <0.001) and degree of mal-alignment (odds ratio; 25.72 (9.30-71.12), p-value <0.001) were also significantly associated with PTOA (Table-2b).

Discussion

In this study we present the five year follow up results of our previously published results of tibial plateau fractures at 24 months. There was a high proportion of patients (45.9%) that developed osteoarthritis following the surgical management of tibial plateau fractures in our study which coincided with the works of Honkonen et al. who reported a 44% incidence of secondary arthritis of the knee.[1] Likewise, Rademakers et al. reported a 27% incidence of arthritis with symptomatic degeneration in cases with malalignment of more than 5 degrees over 14 years, whereas Manidakis et al. reported osteoarthritis in 26.40% patients in his series of 125 patients over 20 months respectively.[9,11] Another large study with follow up of 14 years by Volpin et al. reported the incidence of secondary arthritis to be 23% which developed within 6-8 years of follow up in patients with tibial plateau fractures.[12]

Our results are comparable with other published studies such as Volpin et al. and Honkonen et al[1,12]. who observed PTOA within 6-8 years. Mehin et al. reported endstage arthritis with a mean delay of 4 years following treatment of the initial injury.[10] However, our results are only for bicondylar fractures of the proximal tibia, whereas the previous studies have included all Schatzker fractures ranging from I to VI, respectively. These studies have emphasized the fact that metaphyseal fractures of the proximal tibia are hard to reduce, align and stabilise. In addition, the pattern of injury, range of motion and cartilage nourishment influence the development of osteoarthritis.[14]

Age and gender had an impact on the development of osteoarthritis in our cohorts with the maximum incidence of PTOA observed in the age group > 50 (p=0.01). Stevens et al. pointed out that the age of the patient was strongly related to the development of secondary arthritis following the injury of the proximal tibia.[5] Likewise, Parkkinen et al. noticed that older patients had more advanced secondary osteoarthritis and unsatisfactory functional outcome at follow-up when compared with younger patients.[15] Honkonen et al. observed that patients under 50 years at the time of tibial plateau fractures had signs of PTOA only in the injured knee, whereas patients above 50 years had findings of secondary osteoarthritis in both the injured and the uninjured knee.[1]

Majority of patients 74.3% were males attributed to our social values that men work outdoor. These findings are in keeping with another Indian study done by Jagdev et al. who reported an incidence of PTOA in 73.3% of the population with a mean age of 41.28 years with male domination of 51 out of 60 cases (85%) relating to our society's norms.[16]

Several scoring systems have been used to evaluate the functional outcome of tibial plateau fractures. We assessed the outcome using the American Knee Society functional score having scores between 0 and 100, with a higher number indicating good prognosis. Our study showed a strong correlation with the functional outcome of the patient (AKSS and VAS) and the development of secondary arthritis (p-value 0.00, CI 95%).

The outcome of our study was excellent at 15.6% and good at 32.1%, whereas fair and poor were 22% and 30.3% respectively. Jagdev et al. graded his patients according to the AKSS and achieved an excellent outcome in 86.67% of the cases, 6.66% were graded as good, whereas in 5% fair outcome was attained and in 1.67% patients had a poor result.[16] Manidakis et al. reported good outcomes in 86 cases (69%), fair in 30 (24%) and poor in 9 (7%).[9] The difference between the occurrence of osteoarthritis and AKSS group was statistically significant (p=0.001).

We found that VAS score $\geq$4 is a significant predictor of PTOA in the follow-up period. Manidakis et al. also reported a similar outcome.[9] This can be valuable in informing patients about the outcome that can be expected.

Furthermore, 30 (60%) patients required TKR out of which 70% were males, and 66.7% were of age >50 years. The mean age reported in Scott et al. cohorts was 65.7 years[17] Weiss et al. also reported a similar age of 63 years as compared to Scott et al.[18]

In the present study, we found very strong association of degree of malalignment ($\geq$5°) and articular depression >2 mm with the onset of osteoarthritis in the follow-up period. Parkkinen et al. also reported that mal-alignment and articular depression have a very strong association with the development of PTOA in the follow-up period. They further reported that PTOA is more severe is patients

with higher degree of malalignment.[14] Another latest study by Parkkinen et al. also reported similar results, they reported that initial articular depression of >2 mm and mal-alignment >4° is a significant predictor of PTOA after management of tibial plateau fractures.[19]

Our results are not immune to any shortcomings that the study was retrospective with a 24 month outcomes with a prospective follow up to a minimum five years per patient, with different reported patient reported outcomes instruments utilized in both studies, and conducted at a single centre. On the other hand, the strengths of this study are a long follow up period and being conducted at an urban level 1 trauma centre. Furthermore, to our knowledge this is the first study from Pakistan that gives an insight on the midterm results of surgically operated tibial plateau fractures.

Conclusion

There is a high proportion of osteoarthritis following tibial plateau fixation. The risk factors that related to the development of secondary arthritis in our cohorts were increased age, male gender, a decrease in AKSS and a higher VAS group. Knee arthroplasty is the only option for our cohorts with severe posttraumatic arthritis.

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Ethical Committee Approval: The study was approved by the Institutional Review Board Committee of Jinnah Postgraduate Medical Centre, Karachi, Pakistan with the IRB number of NO.F.2-81/ GENL-2019/ 18270/ JPMC.

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