Fixation of posteromedial fragment combined with anterolateral plating in bicondylar tibial plateau fractures

Mohamed Samy

Department of Orthopaedic Surgery, Menoufia University, Menoufia, Egypt

Correspondence to Mohamed Samy, Orthopaedic Department, Menoufia University, Menoufia 32519, Egypt
Tel: +20 114 653 3241;
e-mail mrmsamy@hotmail.com

Received: 06 November 2022
Revised: 24 Decemer 2022
Accepted: 02 January 2023
Published: 14 April 2023

The Egyptian Orthopaedic Journal 2023, 57:340–345

Background
Three-column classification of tibial plateau fractures had addressed the problems of posteromedial fragment fractures; many authors have discussed the mechanical instability of that fragment. Consideration of specific fixation of this fragment in tibial plateau fracture had been discussed by many authors.
The aim of our study was to evaluate the results of fixation of posteromedial fragment in bicondylar tibial plateau fractures.
Patients and methods
In all, 21 patients were included in this study. All of them had bicondylar fracture tibial plateau fractures, which involve the anterolateral column in conjunction with the posteromedial fragment of the tibial plateau as diagnosed by a computed tomography scan and a three-dimensional scan. All the patients had antigliding plate fixation for posteromedial fragment through the posteromedial approach and anterolateral plate fixation for anterolateral column fracture.
Results
All the patients had completed a minimum 1-year follow-up. All the patients had satisfactory outcomes according to Rasmussen's clinical and radiological scores.
Conclusion
Fixation of the posteromedial fragment in tibial plateau fractures gives good outcomes as regards the stability and function

Keywords:
antigliding fixation, bicondylar fracture tibia, posteromedial fragment, tibial plateau

Egypt Orthop J 2023, 57:340–345

1110-1148

Introduction

Traditional tibial plateau fracture classification systems, include the Schatzker and AO/Orthopaedic Trauma Association classifications [1,2]. However, these systems lack the terminology to accurately characterize fractures involving the posterior tibial plateau in the coronal plane.

Computed tomography (CT) scans have become a routine part of the assessment of tibial plateau fractures. Luo *et al*. [3] in 2010 had introduced the three-column classification based on CT and three-dimensional CT to provide a more comprehensive understanding of the injury patterns and optimizes the treatment approach .The three-column classification had proven to have higher interobserver reliability compared with those of the Schatzker and AO-OTA classification systems [4].

Luo divides the tibial plateau using three intersecting lines dividing the plateau into three columns (medial, lateral, and posterior). The meeting point is the middle of the two tibial spines. The anterior line connects the midpoint of the plateau to the tibial tuberosity. The medial line travels from the midpoint to the posteromedial ridge and the lateral line is drawn from the midpoint to just anterior to the fibular head. Fractures can be defined as zero-, one-, two-, or three-column fractures. With this classification, a column is considered fractured only if a cortical split is present in the column, and a pure depression fracture (Schatzker III) is considered a zero column fracture [3].

Luo *et al*. [3] emphasized that the one-column fracture, which involves the posterior column only or the two-column fracture, which involves the posterior and the lateral column were not applicable when using Schatzker classification alone.

The posteromedial fragment of the posterior column is defined as any posteriorly based articular fracture of the medial plateau with the fracture line exiting the medial cortex.

The presence of a posteromedial fragment was first mentioned in 1967 by Hohl [5], as a split fracture of the posterior condylar margin. He described this fracture

in isolation and not as part of a bicondylar pattern [5]. Biomechanically, the typical posteromedial fracture fragment in tibial plateau fractures had inherited instability outside of full extension. Consideration of specific fixation of this fragment in tibial plateau fractures to be considered even if this fragment is initially seen nondisplaced after injury .The tibial–femoral relationship during progressive flexion is altered, leading to potential displacement if this fragment is not fixed [6].

Posteromedial tibial plateau split fractures are not uncommon, approximately one-third of bicondylar tibial plateau fractures have an identifiable coronal plane posteromedial fragment [7]. The mechanism involved in this fracture pattern may be one of knee flexion, varus, and internal rotation of the medial femoral condyle [8]. The aim of our study was to evaluate the results of posteromedial fragment fixation in bicondylar tibial plateau fractures.

Patients and methods

Twenty-one patients were included in this study, between February 2018 and December 2020. The average age was 39.4 years (ranged from 22 to 56 years). All the patients had two-column fractures (fracture of the posteromedial fragment in conjunction with the anterolateral column of tibial plateau as confirmed by a CT scan). Of the patients, 17 were males and five patients out of 21 had diabetes. The average time between injury and surgical interference was 2 days ranging from 1 to 4 days. Written informed consent was taken from all patients. Approval by medical ethical committee of the faculty of medicine Menoufia university obtained.

Operative technique: the patient was placed in supine position and pneumatic tourniquet was applied. The contralateral hip was rotated toward the injured side resulting in semilateral position of the patient and the injured limb was rotated laterally (that position facilitates access to the posteromedial plateau). Posteromedial approach was used in all patients; the landmarks for the incision are at the medial femoral epicondyle proximally, the joint line, and the posterior tibial border at the level of the metaphyseal–diaphyseal junction distally. Deep dissection was carried out, between the medial gastrocnemius (posterior border of the dissection) and the pes anserinus anteriorly. The medial collateral ligament remains intact anteriorly and deep into the pes anserinus. The pes tendons are mobilized anteriorly and proximally, keeping their insertion intact. The medial gastrocnemius muscle is then elevated and retracted posteriorly and laterally, exposing the posterior proximal tibia. No gastrocnemius tendon release is attempted. The soleus and popliteus muscles are then elevated from the posterior edge of the tibia by a sharp dissection, exposing the fracture site. The joint is not entered posteriorly, carefully protecting the capsular and ligament insertions [9].

In all our patients, the coronal split posteromedial quadrant fragment was large, single, and enough to do reduction at the level of the metaphysis and verified at the joint line by fluoroscopy or by direct observation. Fixation was done either by a locked T-plate or a reconstruction plate. The patient returned to neutral supine position to start fixation of the anterolateral column through the standard anterolateral approach and T-plate either locked or unlocked depending on the stability achieved. Bone substitute block was used in four patients to ensure elevation of the plateau surface, and fixation was done using the T-plate.

Postoperatively all the patients started a protocol of knee exercises (passive then active assisted, finally active). Full weight bearing was not allowed until full union of the fracture (not before 3 months) to avoid collapse at the fracture site. All the patients had completed a minimum

Table 1 Rasmussen clinical score

	Points
Subjective	
Pain	
No pain	6
Occasional pain	5
Constant pain after activity	4
Significant rest pain	0
Walking capacity	
Normal walking capacity	6
Walking outdoors for at least 1 h	4
Short walks outdoors for >15 min	2
Walking indoors	1
Wheel chair	0
Clinical signs	
Extension	
Normal	6
Lack of extension (0–10)	4
Lack of extension >10	2
Total range of motion	
≥140	6
≥120	5
≥90	4
≥60	2
≥30	0
Stability	
Normal stability in extension and 20 flexion	6
Abnormal instability 20 flexion	5
Instability <10	4
Instability >10	2
Score maximum	30
Excellent	27–30
Good	20–26
Fair	10–19
Poor	<10

Table 2 Rasmussen radiological score

Subjective	Points
Articular depression	
Not present	6
<5 mm	4
6–10 mm	2
>10 mm	0
Condylar widening	
Not present	6
<5 mm	4
6–10 mm	2
>10 mm	0
Angulation (valgus and varus)	
Not present	6
<10º	4
10–20º	2
>20º	0
Maximum	18
Excellent	18
Good	12–17
Fair	6–11
Poor	<6

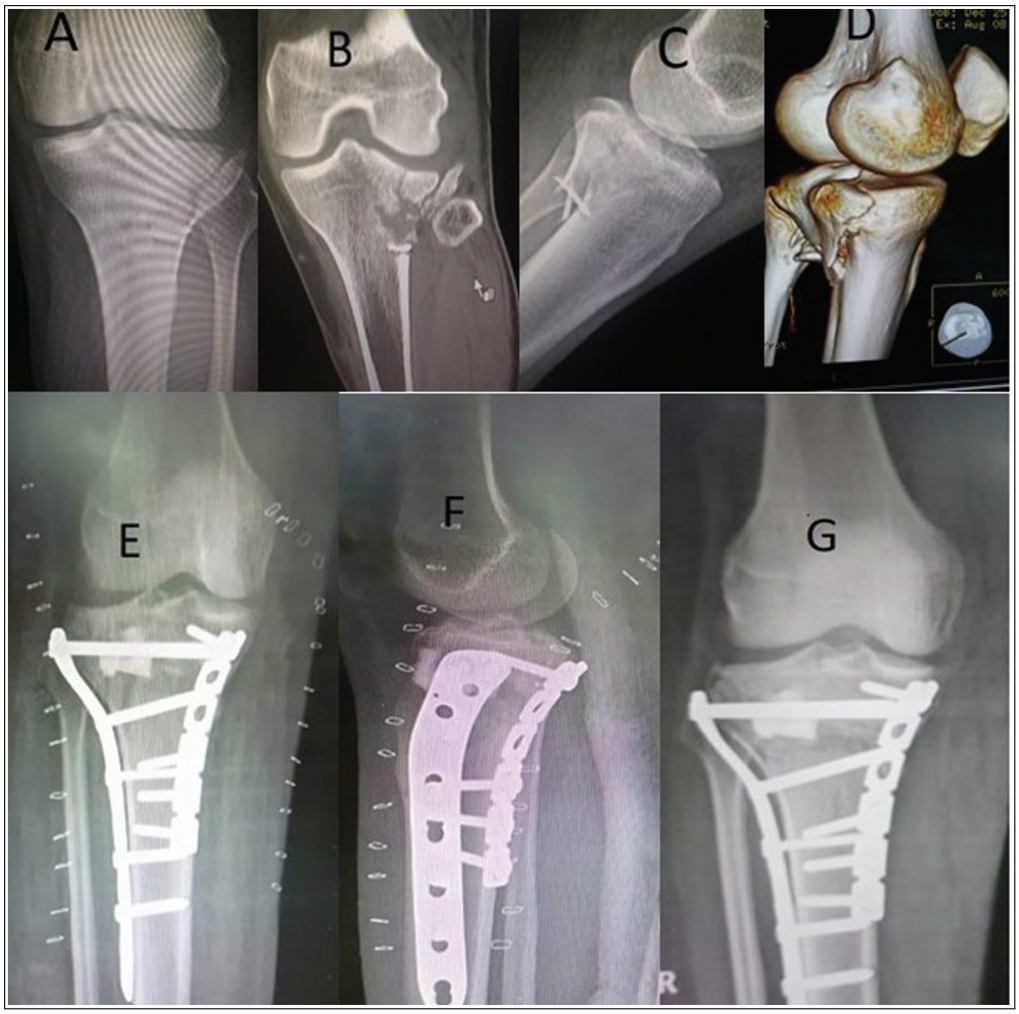
period of 1-year follow-up. At the end of follow-up (minimum 1 year) knee assessment was carried out according to Rasmussen's clinical and radiological scores [10]. Satisfactory results were considered as either excellent or good, and unsatisfactory results were defined as either fair or poor (Tables 1 and 2).

Results

The average duration of fracture healing was of 13.2 weeks range (12–16 weeks). All the patients had completed a minimum 1-year follow-up, range from 12 to 18 months.

All the patients had gained full-knee extension at the end of follow-up, with no fixed flexion deformity. Fourteen patients had excellent outcome and seven got good outcome according to Rasmussen clinical score. According to Rasmussen radiological score 15 patients had excellent outcome and six patients had good one (Figs 1, 2).

Figure 1



(a–d) Preoperative radiograph and computed tomography scan showing bicondylar tibial plateau fractures (posteromedial fragment with anterolateral column). (e and f) Postoperative radiographs showing fixation of the posteromedial fragment with reconstruction plate in an antigliding manner, fixation laterally with the locked proximal lateral tibial plate together with the use of bone block substitute to support the lateral column. (g) End follow-up radiograph and the patient had satisfactory outcome both radiologically and clinically.

Figure 2

(a–c) Preoperative computed tomography scan showing bicondylar tibial plateau fracture (posteromedial fragment with the anterolateral column). (d) Intraoperative C-arm showing fixation of the posteromedial fragment (locked T-plate and anterolateral column with the ordinary T-plate. (e) Postoperative radiograph. (f and g) End follow-up radiograph and the patient had satisfactory outcome both radiologically and clinically.

Discussion

Failure to address the posteromedial fragment in tibial plateau fracture may allow the medial femoral condyle to rotate and subluxate posteriorly, causing instability, pain, and progressive joint degeneration.

The presence of a posteriorly based medial fragment, either in isolation or as part of a bicondylar fracture, had been noted intermittently in the literature since 1967 [5,11–13].

Higgins *et al*. [14] reported that the incidence of posteromedial fragment among 111 patients was 59%, and the average size was 25% of the tibial plateau joint surface area. The mean vertical sagittal angle of the fragment was 73˚, creating unstable shear pattern.

All our patients had a combination of posteromedial fragment fracture in conjunction with anterolateral column fracture. Posteromedial approach in supine position was used to address the fragment and that was closely same as published by Weil *et al*. [9]. Exposure and fixation of the posteromedial fragment was sufficient by the approach. This approach leaves a skin bridge at least 8 cm or more from the anterolateral one. In our study, no patients reported skin problems related to the approach. Also, the supine position had afforded maximum safety to the patient and convenience for the surgeon, and easily shift to the anterolateral column in the second part of surgery.

When the posterior column is fractured by a second split laterally, many authors advice direct posterior approach in prone position [15–19]. In our study, we did not face that situation, as the posterior column was involved in a form of posteromedial fragment in all our patients.

Previous studies have focused on the mechanical load rather than the type of fixation in terms of stability of this fragment [20,21]. More recently, investigations have focused on comparing different types of fixation and the resulting fragment stability. Some authors have suggested that the use of lateral locking plates from the lateral side alone can provide stable fixation in bicondylar fractures [22,23]

Biomechanically that means that the screws coming from the lateral side will be parallel to the fracture plane of the posteromedial fragment and may not hold the fragment [9]. Many authors argue that dual-plate fixation results in improved stability compared with lateral locking plating alone in bicondylar tibial plateau fractures [24–27].

Gosling *et al*. [28] reported using a single lateral locking plating for the treatment of bicondylar tibial plateau fractures; 14% patients showed substantial loss of reduction.

Ratcliff *et al*. [29] had used a cadaveric medial tibial plateau fracture model to compare lateral locked plating with medial buttress plating. They concluded that the medial portion of the bicondylar tibial plateau fracture may be the weakest link in the lateral locking plate system. It is preferable to augment the lateral locking plate with a medial or posteromedial buttress plate to avoid varus collapse. Another group reported by Eggli and colleagues [27] reported to have excellent outcomes after a two-incision-based approach for complex bicondylar tibial plateau fractures.

In our study all our patients had dual fixation; posteromedial antigliding plate for the posteromedial fragment, in conjunction with lateral plating for the lateral column. None of our patients got any loss of fixation or late varus collapse. All the patients had satisfactory clinical and radiological outcomes at the end of follow-up.

Conclusion

Fixation of the posteromedial fragment in bicondylar tibial plateau fracture gives good mechanical stability and satisfactory outcomes.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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