The aim of this study is to describe the morphology of the posteromedial fragment in the setting of bicondylar tibial plateau fractures and to use it as a base for selection of the method of fixation. Twenty two patients with bicondylar tibial plateau fractures involving the posteromedial fragment were included in this study. Plain X-ray and computed tomogram (CT) were performed in all patients. Thirteen patients were treated by dual plating while nine were treated by single lateral plate. The mean posteromedial fragment height was 39 mm. The cephalad surface area percentage of the posteromedial fragment relative to the entire tibial plateau ranged from 10% to 43%, with an average of 28%. The average knee motion at the final follow up was 110°. Two cases were complicated by implant failure. Morphological study of the posteromedial fragment could help in selection of the proper method of fixation.

Keywords: morphological study; tibial plateau fracture; posteromedial fragment.

INTRODUCTION

Displaced tibial plateau fractures with a large posteromedial fragment has been reported in the literatures (1,3,4). There is a controversy about the proper method of fixation of such fracture pattern. The anteroposterior fixation is commonly used in management of such fractures, but adequate reduction is sometimes difficult to achieve. Laterally applied fixed angle plate may be ineffective in treatment of this fracture. Medially based fixation will provide a stable and secure fixation but it requires a separate incision to reach the posteromedial fragment (2,5,6). Lack of information about the morphology of the posteromedial fragment might be a cause for this controversy about the method of fixation. The advent of computed tomography and its three dimensional reformation (3D) has allowed for an accurate assessment of this fracture pattern. In the last few years some studies have emerged to describe the morphology of this fracture based on the CT scan (1,9,14). These studies help to understand the geometry of this fracture pattern.

The aim the present study is to describe the morphology of the posteromedial fragment in the setting of bicondylar tibial plateau fractures and to use it as a base for selection of the method of fixation of this fragment.
MATERIAL AND METHODS

Between March 2009 and August 2012, twenty two patients with bicondylar tibial plateau fractures involving the posteromedial fragment were treated in our institution. There were 7 females and 15 males. The ages ranged from 24 to 68 years with an average of 41 years. The injury was due to road traffic accidents in 11 patients, fall from a height in nine patients and fall of a heavy object over the leg in 2 cases. Five cases were initially treated by a spanning external fixator to manage the associated soft tissue problems. Cases with open fractures or compartment syndrome were excluded from the study. All patients were evaluated clinically and radiologically by plain X-ray and computed tomogram (CT). The morphological characteristics of the posteromedial fragment were described using the CT scan according to the parameters proposed by Barei et al (1). Three important parameters were measured; the medial articular fracture angle (MAFA), the cephalad surface area percentage (CSAP) and the posterior cortical height (PCH). The medial articular fracture angle is determined on the transverse cut at the level of the articular surface by measuring the angle between the major fracture line of the medial tibial plateau and the posterior femoral condylar axis (Fig. 1A). The posterior femoral condylar axis (PFCA) is a line connecting the posterior aspects of the femoral condyles in the transverse cuts at the level of the femoral epicondyles. It acts as a neutral axis of the coronal plane (Fig. 1B).

The cephalad surface areas percentage (CSAP) of the major postero medial fragment relative to the entire tibial plateau is determined on the transverse cuts taken at the level of the articular surface (Fig. 1C).

Communion involving the articular surface along the major medial articular fracture line is also noted. The posterior cortical height (PCH) is defined as the length of a straight line connecting the most posterior aspect of the articular surface with the most distal aspect of the postero medial fragment on the sagittal cut or 3D reformations (Fig. 1D).

From these measurements; the medial articular fracture angle (MAFA), the posterior cortical height (PCH) and the cephalad surface area percentage (CSAP), we could have a good idea about the size and orientation of the postero medial fragment and its fixation is designed accordingly. The following protocol of management was used; if the surface area percentage of the postero medial fragment is less than 25% of the entire tibial plateau or the posterior cortical height is less than 30 mm the pos-
Postoperative care includes early mobilization with active assisted and passive range of motion exercises starting on the second postoperative day. Weight bearing is restricted during the first eight weeks then progressive weight-bearing is allowed according to the bone healing on serial radiographic examination. At the final follow-up, the range of motion of knee joint was measured and the Modified Hospital for Special Surgery knee scoring system was used for evaluation of the patients (16).

**RESULTS**

The cephalad surface area percentage of the posteromedial fragment relative to the entire tibial plateau ranged from 10% to 43% with an average of 28%. The MAFA ranged from -3 to 46 degrees with a mean of 25 degrees external rotation relative to the PFCA. The cortical height of the posteromedial...
The key objectives in treatment of tibial plateau fractures are: anatomical reduction of the articular surface, maintenance of normal knee alignment, and stable fixation to allow for early joint motion (20,21,22). The posteromedial fragment in the setting of bicondylar tibial plateau fractures seems to be under-recognized or recognized but under-treated. Failure to address this fragment may allow the medial femoral condyle to rotate and subluxate posteriorly causing instability, pain, and progressive joint degeneration (11,12). Management of this fracture pattern remains difficult and controversial.

The most commonly used approach to treat medial tibial plateau fractures is fixation with an anteromedial plate through a medial parapatellar incision (25). This approach however does not give adequate exposure. Attempts to reduce and fix the posteromedial fragment may be difficult and result in extensive soft tissue dissection (21,25).

When it is fixed with a lateral locked plate, the screws fail to capture the posteromedial fragment because it is frequently parallel to the fracture line (18). Locking screws directed from the lateral plate to secure the medial fragment possess a limited ability to lag the medial fragment and rely on the lateral screw-plate interface to withstand shearing forces (5). Gosling et al (6), reported a series of bicondylar tibial plateau fractures treated with single lateral locked plate. In that series, 26% of the cases demonstrated loss of reduction secondary to failure.
operative CT scan to analyze bicondylar tibial frac-
ture (7,10,13).

We hypothesize that the size of the posteromedial
fragment may have a role in selection of its fixation
method. The bigger the fragment the more the sheer
force applied to it and the less likely of its stabiliza-
tion through a single lateral plate. Bari et al
(1) described the frequency and morphology of the pos-
teromedial fragment in bicondylar tibial plateau
fractures based on the CT study. They found that ;
increasing posterior cortical height is significantly
associated with the absolute surface area percentage
of the posteromedial fragment (P, 0.001). Thus, the
posterior cortical height and the surface area per-
centage give an idea about the actual size of the
posteromedial fragment and the medial articular
fracture angle (MAFA) gives an idea about the

to reduce or stabilize the posteromedial articular
fragment. Recent biomechanical evidence implies
that dual plating increases resistance to subsidence
when compared with a unilateral locking plate in
bicondylar fractures (8).

But does every medial fragment require a separate
plate for its fixation ?

Better understanding of the different fracture
patterns helps to formulate a good treatment plan.
To date, most of descriptions of tibial plateau frac-
tures have concentrated on their appearance on the
antero-posterior radiograph, with little comment on
any primary displacement in the sagittal plane (15,19,
23). Hackl et al (7) found that 40% of the fractures
classified with plain radiographs and the AO system
had to be changed after performing a CT scan.
Therefore, most authors now recommend a pre-

Fig. 3. — A : The radiographs of a 47 year-old male patient with right bicondylar tibial plateau fracture with a large posteromedial
fragment. B : The transverse CT cut showing that the posteromedial fragment represents about 38% of the entire tibial plateau surface
area. C : The early post operative radiograph after dual plating. D : After healing of the fracture. E : The patient with good alignment
and good range of knee movements.

Acta Orthopædica Belgica, Vol. 82 - 2 - 2016
orientation of the fracture line. So, these parameters were used to formulate the protocol of management in the present study.

All cases that were treated by dual plating healed in a good alignment and none of them showed implant failure while two of the cases that were treated by screws through the lateral plate showed implant failure and varus collapse. The cephalad surface area percentages of the posteromedial fragment in these two cases were 21%, and 24% respectively. They were treated by re-fixation by a buttress plate through a posteromedial approach and they united in a proper way. Thus, by the end of our study we could recommend single plate fixation for bicondylar tibial plateau fracture with a small posteromedial fragment (CSAP ≤ 20% or PCH ≤ 30 mm) and dual plating for cases with a large posteromedial fragment (CSAP more than 20% or PCH more than 30mm). The presence of comminution along the posteromedial fracture is an exception and it requires a separate buttress plate from the same side as it is difficult to be fixed by screws from the opposite side. Open reduction and internal fixation of bicondylar tibial plateau fractures has a high rate of postoperative complications, mainly due to severe concomitant soft tissue injury (2,17). In this series there were no infection or soft tissue problems after dual plating because the bilateral approaches through the posteromedial and anterolateral incisions leaves a large vital skin flap between the 2 incisions that minimize the risk of soft tissue complications.

CONCLUSION

Morphological study and careful preoperative planning of the surgical treatment of this fracture pattern could help in selection of the proper method of fixation and improve the final outcome.

REFERENCES


