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A comparison of lateral fixation versus dual plating for simple bicondylar fractures

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ABSTRACT

Background: The best fixation method for bicondylar tibial plateau fracture is debated. The aim of this study was to compare the effect of a lateral locking plate with that of dual plates in the treatment of tibial plateau fracture with a relatively intact medial condyle fragment.
Methods: Eighty-six patients diagnosed with a bicondylar tibial plateau fracture with a relatively intact medial condyle were assigned to groups treated with either dual buttress plates (DP group) or a lateral locking plate (LP group). Preoperative characteristics, surgical details, and postoperative complications were recorded and compared between groups. Hospital for Special Surgery Knee Scoring System score was used to evaluate clinical outcome.
Results: Both groups displayed satisfactory clinical and radiographic results. There were no significant differences in associated preoperative conditions between the DP and LP groups. Durations of hospital stay and operation were significantly shorter, and blood loss significantly less, in the LP group than in the DP group ($P = 0.045;0.038;0.031$). The rate of delayed-union was significantly lower in the LP group than in the DP group ($P = 0.023$).
Conclusion: Both dual-plate and lateral locking-plate fixation can provide satisfactory treatment of bicondylar tibial plateau fractures if properly used. When the medial tibial condyle is relatively intact, a lateral locking plate can provide stability similar to that of dual plate while decreasing operative duration and soft-tissue complications, which can assist fracture healing and shorten hospital stay.
Level of evidence: I — Randomized controlled trial.

1. Introduction

Fracture of the tibial plateau accounts for 1.3% of all fractures, and in China, the number of complicated fractures of the tibial plateau has increased with the widespread use of modern vehicles. Serious intra-articular damage and soft-tissue injury or incorrect treatment can lead to postoperative complications such as skin necrosis, infection, non-union, deformity, and traumatic arthritis. The treatment of bicondylar tibial plateau fractures remains challenging, even to experienced orthopedic surgeons [1–3].

The goals of operative treatment include anatomic reduction with restoration of articular congruity and rigid fixation to allow early motion. Strategies such as dual buttress plates, locking plates, external fixators, and a combination of internal and external fixation have been advocated for the management of bicondylar tibial plateau fractures, but there is no consensus guideline for treatment of this kind of fracture [4–6]. A single lateral locking plate can decrease the risk of skin damage, ligament damage, and wound infection, but because of its design, it cannot provide sufficient stability and satisfactory reduction of the medial condylar fragment, especially in cases of comminution or coronal fracture [7–9]. The advantages of dual-plate technique are in visual reduction and maintaining proximal tibial alignment, but soft-tissue complications and damage to the periosteal blood supply are major concern in this method of fracture internal fixation [10,11]. Many surgeons remain suspicious of the quality of fracture reduction and stabilization provided by an external fixator for complicated tibial plateau fractures [12].

In the normal knee, approximately 60–75% of weightbearing forces are transmitted through the medial plateau [13,14]. Insufficient fixation can easily lead to collapse of the medial plateau. Although the tibial articular surface also seems to tolerate some degree of residual incongruity, stabilization and alignment have proven to be important factors affecting the rate of arthrosis and clinical outcomes. Stabilization is also important in medial plateau fractures to avoid medial collapse and subsequent varus malalignment [15].

We wondered whether a single lateral locking plate could provide stabilization as effective as that provided by dual plates in cases where

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there is a relatively intact medial condyle fracture fragment without comminution or coronal fracture. In this prospective study, we used either a single lateral locking plate or dual buttress plates (Königsee Implantate GmbH, Allendorf, Germany) for fixation of bicondylar tibial plateau fractures if the medial fracture fragment was relatively intact. The purpose of this study was to compare the effect of a single locking plate and dual buttress plates in the fixation of tibial plateau fracture with a relatively intact medial condyle.

2. Material and methods

2.1. Patients

Patients who underwent surgical treatment for a diagnosis of bicondylar tibial plateau fracture at our two affiliated university hospitals between May 2007 and May 2011 were included in the study. Inclusion criteria were the presence of a bicondylar tibial plateau fracture (Orthopaedic Trauma Association [OTA] type C) with a relatively intact medial tibial condyle without comminution or a coronal fracture line); exclusion criteria were pathologic, pediatric, extra-articular proximal tibial fractures, serious open fractures (Gustilo grade III) and polytrauma with serious head or chest injury. All patients were treated by two teams of surgeons according to standard procedure. A pre-study power analysis indicated that to have an 80% chance of detecting a 25% difference in Hospital for Special Surgery Knee Scoring System scores (HSS scores) between groups ($\alpha = 0.05$), approximately 40 patients would be required in each group. The study was approved by the research ethics committee of Anhui Medical University.

Eighty-six patients met the inclusion criteria and were enrolled in the study. Preoperative radiographic examinations consisted mainly of X-ray plain films and computed tomography (CT) scans and reconstructions before definitive surgical fixation (Figs. 1 and 2). CT scans were more useful in evaluating comminution of the bone fragments, coronal fracture line and articular depression. Patients were randomly assigned to one of two groups, a dual-plate (DP) group and a locking-plate (LP) group, using computer-generated random numbers.

2.2. Operative technique

All patients were treated with transcalcaneal skeletal traction for 7–14 d after admission to allow soft-tissue injury and swelling to subside, maintain fracture alignment, and alleviate pain. Patients with open wounds were treated with surgical debridement within eight hours of injury and with intravenous antibiotics to prevent infection. Prophylaxis against tetanus was also administered for open wounds. Once biochemical examination had finished and the condition of the soft tissue at the site of injury had improved (such as knee and lower leg swelling subsided, healing of fracture blisters, and wrinkling of the skin around the proximal tibia), internal fixation was performed.

Using a lateral approach, a lazy-S incision centered on Gerdy's tubercle was created. The knee capsule was incised and the meniscus drawn upward with a holding suture to expose the articular surface. The incision was extended distally, staying at least 1 cm away from the tibial crest, and the fascia was incised and elevated with retractor. The anterior tibial muscle was dissected subperiosteally from the lateral aspect of the proximal tibia, and the anterior tibial neurovascular bundle was protected in the muscle.

In the DP group, a medial approach was used to create two incisions parallel to the posteromedial border of the proximal part of the tibia, with the distance between the incisions greater than 7 cm. After skin incision and dissection of the subcutaneous layer, a medial approach was performed through the interval between semimembranosus and the medial head of the gastrocnemius. The pes anserinus tendons were retracted anteriorly and the gastrocnemius muscle was retracted posteriorly. The semimembranosus insertion was released if necessary to expose the posteromedial edge of the tibial plateau [16]. Because the medial fragment was relatively intact, the articular surface did not need to be exposed, and a T- or an L-shaped buttress plate could be used to fix the bone fragments. The plate could be moved backward or forward depending on the positions of the fracture fragments.

If a joint line depression was more than 2 mm, we restored the articular surface from below. The collapsed lateral articular surface could be elevated through the “fracture window” at the fracture site using a periosteal elevator; at the same time, we tried to raise the articular surface of the medial plateau from a lateral approach, using an autograft of ilial bone to repair the residual bone defect. We used K-wires to secure the fragments temporarily in order to ensure a smooth articular surface before plate fixation. The medial plateau bony cortex was relatively intact, so the medial condyle is fixed first in DP group. An anterior or posterior cruciate ligament avulsion fracture was treated with a lag screw. Areas of peripheral meniscal detachment were exposed and repaired using non-absorbable sutures.

2.3. Postoperative management and follow-up

Mobilization of the knee joint using a continuous passive-motion machine was started on postoperative day two, and analgesics were provided. Toe-touch weightbearing was started in the sixth postoperative week. Full weightbearing was begun when radiographic healing of the fracture was observed. Anteroposterior (AP) and lateral plain films of the operated knee were taken immediately postoperatively and three, six, and 12 months postoperatively to ensure complete fracture healing (Figs. 1 and 2). Assessment of knee function, including HSS score and knee range of motion, was performed during the follow-up period. Mechanical and pharmacologic deep venous thrombosis prophylaxis was provided during the perioperative period. Anticoagulation was used for up to three weeks postoperatively in high-risk cases.

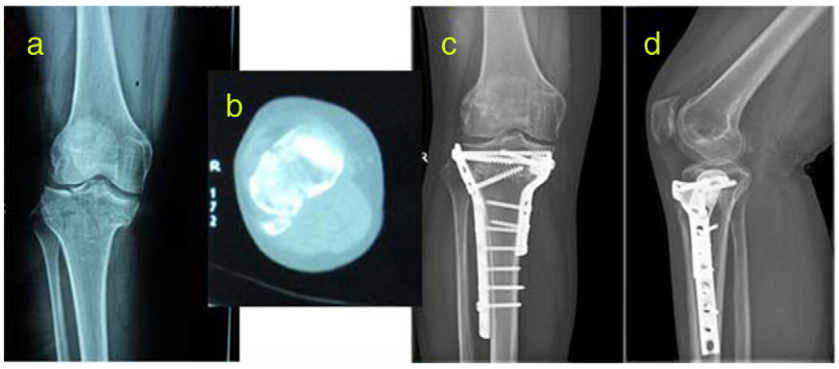

Fig. 1. A 41-year-old woman with an OTA 41C-2 fracture treated with dual-plate fixation. (a) Preoperative X-ray. (b) CT scan showing a relatively intact medial tibial condyle. (c) Anteroposterior X-ray performed 16 months postoperatively. (d) Lateral X-ray 16 months postoperatively. CT, computed tomography; OTA, Orthopaedic Trauma Association.