Original Article

Study of outcomes of dual plate osteosynthesis in Schatzker type 5 and 6 fractures of proximal tibia

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ABSTRACT

Background: The operative treatment of complicated bicondylar fractures of the tibial plateau remains a challenge to even the most experienced surgeons. Such injuries are usually the result of high-energy trauma, and the management of such fractures is complicated by metaphyseal and articular comminution and the frequent occurrence of associated soft tissue injuries.

Aims: The aim of this retrospective study was to evaluate the clinical and radiological outcomes of dual plating for treating Schatzker types 5 and 6 bicondylar tibial plateau fractures.

Methods: 24 patients with bicondylar tibial plateau fractures and operatively treated in our orthopedic department with dual-plating technique between January 2006 and December 2012 were retrospectively analyzed. Inclusion criteria for this study were (1) acute and unilateral fractures and (2) displaced bicondylar tibial plateau fractures (Orthopaedic Trauma Association types C1, C2, and C3).Knee score was used for evaluation of outcome

Results: At 12 months postoperatively, the knee score was 88.5 and 84.4in the double buttress plate and combination plate groups, respectively, and the difference was not significant. Out of 24 patients 19 achieved excellent knee score (>90), 4 achieved good (80-90), 1 achieved fair (70-80) and no patient had poor (<70) knee score. Mean range of knee flexion was 115 degrees for dual buttress group and 117.5 degree for combination group.

Conclusion: Dual plating in Schatzker type 5 and 6 fractures results in good outcome with low complication rates.

Key words: Dual Plate, Proximal Tibia, Schatzker, Bicondylar Tibia

INTRODUCTION

The operative treatment of complicated bicondylar fractures of the tibial plateau remains a challenge to even the most experienced surgeons. Such injuries are usually the result of high-energy trauma, and the management of such fractures is complicated by metaphyseal and articular comminution and the frequent occurrence of associated soft tissue injuries [1]. The ideal fixation method remains controversial. Treatment options include limited internal fixation combined with tensioned-wire or hybrid external fixation[2], fixed-angle implants using percutaneous exposure and reduction [3], lateral peri articular plates[3,4], and dual plating [4]. Dual plating via a 2-incision technique has received recent support because it allows for direct visualization of the articular reduction while minimizing the need of stripping the soft tissues in the fracture area, especially when significant displacement in the posteromedial fragment or articular depression of the medial plateau exists [5].

As fixed-angle implants, locking plates are mostly used in metaphyseal fractures. We assumed that locking plates might be able to reduce secondary loss of reduction in bicondylar tibial plateau fractures; therefore, locking plates in combination with buttress plates were used to fix bicondylar tibial plateau fractures in most of our patients in a dual-plating technique [6].

The purpose of this retrospective study was to evaluate the clinical and radiological outcomes of dual plating for treating Schatzker types 5 and 6 bicondylar tibial plateau fractures. The results using a double buttress plate and a combination of locking plate and buttress plate were also compared.

MATERIAL AND METHODS

24 patients with bicondylar tibial plateau fractures and operatively treated in our orthopedic department with dual-plating technique between January

2006 and December 2012 were retrospectively analyzed.

Inclusion criteria for this study were (1) acute and unilateral fractures and (2) displaced bicondylar tibial plateau fractures (Orthopaedic Trauma Association types C1, C2, and C3) [7, 8].

Exclusion criteria for this study were pathologic fractures, definitive surgery 3 weeks after the injury, pre-existing joint disease (osteoarthritis, inflamma-tory arthritis, or a prior fracture), severe systemic illness (active cancer, chemotherapy, insulin-dependent diabetes mellitus, renal failure, haemophilia, or medical contraindication for surgery), open growth plates, vascular injuries requiring repair (a Gustilo grade IIIC fracture), age older than 65 years, or severe head injuries (initial Glasgow Coma Scale score ≤8) or other neurological conditions that would interfere with rehabilitation [7,8,9].

This study was approved by the hospital Ethics Committee.

Injury and postoperative radiographs and computed tomography (CT) scans were used to identify each bicondylar fracture. Associated injuries and postoperative wound complications were recorded. Data pertinent to postoperative functional status were also recorded. Deep infections were defined as those that extended below the fascia; superficial infections remained above the fascia [10].

Patients with open wounds underwent surgical debridement within 8 hours of injury and subsequently received tetanus prophylaxis and intravenous antibiotics. All patients were managed with transcalcaneal skeletal traction [11] for adequate time to allow soft tissue healing. The leg was elevated. Physical therapy was also performed to facilitate soft tissue healing. For open fractures, the wound was radically debrided and profusely lavaged. The wound was closed primarily or after a repeat irrigation and debridement within 48 to 72 hours, depending on the extent of contamination and soft tissue damage. Antibiotics (cefuroxime and metronidazole) were prescribed for the first 5 days. Clinical signs of soft tissue recovery included decreased swelling, healing of Fracture blisters, and wrinkling of the skin around the proximal tibia [11, 12]. Decisions regarding fixation method and timing were guided by the surgeon’s experience and judgment. The technique for fixation of closed fractures was similar to that described by Barei et al [12, 13]. Fixation of the medial column was performed first, using an incision made 1cm posterior to the posteromedial border of the tibial metaphysis, with dissection through the interval between the pes anserinus tendons and the medial head of the gastrocnemius. When the medial plateau fracture contained a sagittal split involving the articular surface, the fracture site was entered and the coronary ligaments were elevated to expose the medial meniscus and the depressed joint surface. This required splitting of the medial collateral ligament in line with its fibers. The anterolateral incision was started 1 to 2 cm lateral to the patella and extended distally over Gerdy’s tubercle and 1 cm lateral to the crest of the tibia. A transverse submeniscal arthrotomy was performed to expose the articular surface. Subperiosteal dissection was limited to the fracture margins and the region of anticipated plate application. Depressed fragments were elevated and supported with autograft harvested from iliac crest or allograft. Buttress plates or locking plates were applied once anatomic reduction had been achieved. In the double buttress plate group, the medial and lateral plateaus were fixed with buttress plates. In the combination plates group, a locking plate was used on the side with relatively more severe fracture comminution and the other side were fixed with a buttress plate [12, 13].

Plain radiographs were taken to verify adequate articular reduction and implant placement. The menisci and cruciate ligaments was examined and identified, and soft tissue injuries were repaired if possible. In open fractures, incisions were based on the fracture pattern and location of the traumatic wounds.

The goal was to limit creation of large laps and to minimize soft tissue stripping [13]. All patients had a similar postoperative regimen and were followed up at regular intervals for at least 12 months. Ranges of motion (ROM) exercises were started with the supervision of a physical therapist once the incisions were sealed and dry [12, 13, and 14]. A hinged brace was used for 12 to 16 weeks if the anterior cruciate ligament (ACL) was injured [14]. Patients were instructed to remain nonweight bearing for a minimum of 6 weeks, and then partial weight bearing was allowed. Full weight bearing was not allowed until bony healing was seen on radiographs [13].

During the follow-up period, fracture healing time and postoperative complications were recorded. Radiographs during the immediate postoperative and subsequent follow-up period were reviewed for all patients. Knee function evaluation was performed at least after 12 months according to Knee Society Scores [14.15].

Malreduction of the articular surface was defined as an intra-articular step-off of at least 2 mm measured on scaled radiographs. Alignment of the proximal tibia was determined by measuring the tibial plateau angle (the medial angle between the tangential line and anatomic axial of the tibia) on anteroposterior radiographs and the posterior slope angle (the angle between the tangential line of medial plateau and the perpendicular line of the anterior tibial cortex) on lateral radiographs; tibial plateau angle >90° or <80° or posterior slope angle >15° or <25° was considered indicative of malalignment [15].

Secondary loss of reduction was defined as an increase of 2 mm of Intra-articular step-off, and secondary loss of alignment was defined as an increase of 3° malalignment when compared with the first postoperative radiograph [15]. Bony union was defined radiographically by the treating surgeon as >3 cortical unions during the follow-up period. Non-union was defined as no evidence of healing after 9 months [16].

RESULTS

Twenty four patients met the criteria for this study, and all patients were followed-up for at least 12 months. Age range of patients included was 25 years to 59 years, with mean age 49.59±11.9 years. 21 patients were male, while 3 were female. 75% injuries were due to road traffic accidents. 10 fractures were Schatzker type 5 fractures, and 14 were Schatzker type 6 fractures [1]. 20 fractures were close, and 2 were open grade 1 and 2 were open grade 2 fractures according to Gustilo classification [8]. 3 patients had head injury and 1 had chest trauma. Most of the patients were treated within 7 days of injury.

The data of these 24 patients were analyzed. Of the 24 patients, 4 were fixed with a double buttress plate and 20 were fixed with a combination of locking plate and buttress plate.10 patients were treated with single incision approach and 14 were treated with dual incision approach. No significant difference existed regarding follow-up time, mechanism of injury, fracture type, open fracture grade, age, sex distribution, and associated injuries between the groups. No significant differences existed regarding operative time, tourniquet time, blood loss, and soft tissue injury repairing between the groups.

Complications included 4 infection in which 3 were superficial and 1 was deep infection; 1 loss of reduction and 3 loss of alignment, and 4 implant impingement, 1 peroneal nerve palsy. 3 superficial infections were treated by local care of the incisions and oral antibiotics. 1 patient who developed deep infection healed after debridement, repeat irrigation, and intravenous antibiotics.

No malreduction or malalignment was measured on the first postoperative radiographs. At final follow-up, secondary loss of reduction was found in 1 patient; secondary loss of alignment was found in 2 patients in the double buttress plate group and 1 patient in the combination plate group. Loss of tibial plateau angle was 3° to 8°. Knee instability was found in 0 patients. At 12-month follow-up, early arthritis with joint space narrowing was found in 2 patients. Most of these patients had minor pain in the knee, and 1 patient in the double buttress plate group and 1 patient in the combination group had medium pain.

At 12 months postoperatively, the knee score was 88.5 and 84.4in the double buttress plate and combination plate groups, respectively, and the difference was not significant. Out of 24 patients 19 achieved excellent knee score (>90), 4 achieved good (80-90), 1 achieved fair (70-80) and no patient had poor (<70) knee score. Mean range of knee flexion was 115 degrees for dual buttress group and 117.5 degree for combination group. Infection was more common in single midline incision approach (3 patients) then dual incision approach (1 patient).

Table 1: Outcome of dual plates in type 5 & 6 fractures

Type of fracture	Plates used	Approach	Number of patient	Mean Knee score	Mean Functional score	Mean ROM
Type 5	Dual buttress	Single incision	2	87	82	110
		Dual incision	2	90	88	120
	Locking + buttress	Single incision	2	80	82	100
		Dual incision	4	85.5	80	110
Type 6	Dual buttress	Single incision	0	-	-	-
		Dual incision	0	-	-	-
	Locking + buttress	Single incision	6	85	90	125
		Dual incision	8	84.5	92	120

DISCUSSION

The treatment of complicated bicondylar tibial plateau fractures resulting from high-energy trauma is challenging due to severe comminution, damage to the articular surface, and associated soft tissue injuries. Although follow-up times in the current study were not adequate to obtain long-term outcomes, the 12-month results are satisfactory according to the knee scores, with a low rate of complications.

Soft tissue complications are a major concern in the treatment of bicondylar tibial plateau fractures with dual plates and have been reported to be as high as 23% to 100% with dual plates through a single incision. With advances in surgical technique, the deep infection rate has been reported to have reduced to 4.7% with dual plates through 2 incisions. To minimize soft tissue stripping, small wire external fixators were explored for the treatment of tibial plateau fractures. Deep infection and osteomyelitis remain a significant problem, with rates between 7% and 13%. The deep infection rate in the current study was 3.8%, which was lower than previous reports. We believe that gentle handling of the soft tissues with a nontraumatic technique and a staged surgery allowed

Image 1 : A - anteroposterior view Schatzker type 6 fracture; B - lateral view Schatzker type 6 fracture ; C- Reduction after T scan image; D- per op fluoroscopic view showing fracture reduction; E & F- immediate post operative reduction

the compromised soft tissue to heal before definitive fixation and helped reduce soft tissue complications and infection rate. All patients in the current study were managed with transcalcaneal skeletal traction for 3 to 10 days during the first stage, which also helped to restore leg alignment and maintain soft tissue length while facilitating healing and preventing further soft tissue damage [17].

The goals of operative treatment for bicondylar tibial plateau fractures are to reconstruct the congruity of the articular surface, restore normal alignment of the lower extremity, and provide stable fixation to allow for early knee joint ROM[18]. Several fixation techniques have been explored for the treatment of such fractures. A recent multicenter prospective study conducted by the Canadian Orthopaedic Trauma Society reported that a circular external fixators yielded similar clinical outcomes but with fewer complications [4]. However, insufficient fracture reduction due to poor visualization and superficial or pin tract infections concerns many orthopedic surgeons.

Less Invasive Stabilization System fixation offers the advantages of indirect fracture reduction, percutaneous sub muscular implant placement, and a fixed angle structure. Several studies have reported encouraging results with this technique; however, favourable reports are often only from case series. Gosling et al [19] evaluated the Less Invasive Stabilization System used alone to treat 69 bicondylar tibial plateau fractures and reported that 16 patients had a significant malreduction and 9 patients had a loss of reduction. Dual plating is preferred to fixed-angle implants in a significantly displaced fracture of the medial articular surface. A 2-incision double-plating technique is recommended by the Association for Osteosynthesis/Association for the Study of Internal Fixation for the treatment of bicondylar tibial plateau fractures.

Because locking plates provide angle stability, it is hypothesized that using locking plates instead of buttress plates may help prevent secondary loss of reduction and alignment [17]. However, our results showed no significant difference between the double buttress plate group and the combination group in the rate of secondary loss of reduction and alignment. Further review showed that all patients with secondary loss of reduction or alignment received no or insufficient bone graft during open reduction and internal fixation [18]. The bone graft, not the choice of internal fixation device, affected the occurrence of secondary loss of reduction and alignment. When secondary loss of reduction or alignment occurs, osteoarthritis occurs even if the primary reduction was satisfactory. Although our results showed that using the combination of locking plate and buttress plate did not result in better clinical or radiographic outcomes, it had the advantage of reducing the amount of bone graft compared with the double buttress group in some studies. In our study, bone graft was not used in any patients.

CONCLUSION:

Our preliminary results showed that treating complicated bicondylar tibial plateau fractures with dual plating via a 2-incision technique resulted in satisfactory clinical and radiologic outcomes with an acceptable complication rate. A limitation of this study may be that although fracture healing occurred, follow-up was relatively short. In addition, because of the difficulty of quantifying the degree of soft tissue damage, the effect of soft tissue damage on the outcome of this type of fracture was not evaluated.

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