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Comparative study of functional outcome of unilateral locking plate and dual plating in the treatment of bicondylar proximal tibia fractures

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Abstract

Background: Proximal Tibia Fracture (PTF) includes different fracture patterns with varied degrees of articular depression and displacement. Many kinds of fixators, including newly designed plate with locking screws were applied to treat these complicated fractures. We intended to follow up the surgical outcomes of 1. Unilateral locking plate and 2. Classic dual plates.

Materials and Methods We retrospectively reviewed 66 patients with PTF, Schatzker types V and VI, who we operated in our institute. Excluding patients who expired due to other medical conditions and without complete follow-up. A scheme of surgical intervention was designed by visiting staff, and 15 patients, as Group I, were treated with unilateral locking plate. The other 19 patients, as Group II, were treated with classic dual plates (one lateral approach locking compression plate (LCP)+medial anti-gliding plate). All patients were under periodic follow up at about 6 weeks interval for at least 18 months postoperatively.

Results: In Group I, 11 cases achieved solid bony union without obvious traumatic OA change, limitation of ROM, or malalignment. In Group II, 17 patients reached the same goal, respectively. By analysis of the recorded parameters with statistical software (SPSS 12.0), there were five parameters with significant difference, including Schatzker classification, Operation time, Staged treatment done or not done, Period of hospitalization and Hardware impingement.

Conclusion: Our study shows Dual plating provides better stability and outcome than unilateral plate fixation for Schatzker type V and type VI fractures. On clinical follow up one should keep a close eye.

Keywords: bicondylar, periarticular, Schatzker types, malunion, tibial plateau, dual plating

Introduction

Proximal tibia fractures (PTFs) have a complicated intra-articular fracture pattern, representing approximately 1.2% of all fractures. Surgical treatment for high-energy displaced bicondylar fractures of the tibia plateau remains a challenge for most surgeons [1]. According to the Schatzker classification, types V and VI are complex fractures often associated with soft tissue injury, a high risk of wound complications, difficulty in reduction, and further sufficient fixation for stabilization [2]. However, the ideal fixation method is not yet clear, and treatment options include screws, an external fixator, hybrid external fixation, limited internal fixation combined with a tensioned wire, classic dual buttress plates, a unilateral periarticular locking plate, and hybrid dual plates (combination of locking plate and buttress plate).

The purpose of this retrospective study was to analyze our experience with consecutive high-energy tibial plateau fractures, Schatzker type V or type VI, involving a bicondylar component, which were managed using a unilateral periarticular locking plate, classic dual buttress plates, or hybrid dual plates (combination of locking plate and buttress plate).

Materials and Methods

We retrospectively reviewed 66 patients with PTF, Schatzker types V and VI, who we operated from June 2012 to May 2015 in our institute Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, Chinnoutapalli, tertiary care, teaching hospital in South India.

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Excluding patients who expired due to other medical conditions and without complete follow-up, 34 patients In highly unstable bicondylar fractures, open reduction and internal fixation (ORIF) with dual plating has been biomechanically proven as an effective method for stabilization after reduction of both fracture fragments and articular surfaces. However, fixation with dual plating requires extensive soft tissue dissection and thus increases the risks of wound complications (3). There are many journals using a unilateral periarticular locking plate in the treatment of bicondylar PTFs with a lower risk of soft tissue damage and surgical site infection. They reported that both stabilization methods are equally were sorted out in this series. The scheme of surgical intervention was designed by visiting staff, and 15 patients, as group I, were treated with unilateral locking plate. The other 19 patients, as group II, were treated with classic dual plates (one lateral approach locking compression plate (LCP)+ medial anti-gliding plate). All patients were under periodic Follow up at about 6 weeks interval for at least 18 months postoperatively.

The inclusion criteria of this study were the presence of bicondylar PTFs Schatzker type V/VI, patients aged over 18 years, and the ability to walk without assistance before injury. Polytrauma patients with PTFs with an injury severity score (ISS) >16 and patients with bilateral plateau fractures were excluded from this study. Cases with suspected pathologic fracture, in which the patient expired, or in which the patient has other medical conditions resulting in failure in the evaluation of functional outcome Thirty four patients with complex tibial plateau fractures were enrolled, and the study group consisted of 19 males (53%) and 15 females (47%) with an average age of

51.68 years (range 18 ~ 83 years). The mechanism of injury was motor vehicle accident in 28 patients, and the others were falls from height. All patients had anteroposterior and lateral view radiographs at our emergency department initially, and a CT scan was performed if the fracture pattern was difficult to classify. There were 18 Schatzker type V (55.5%) and 16 Schatzker type VI (44.4%) fractures.

The soft tissue condition was the most crucial item on our preoperative planning for the timing of the operation and the choice of surgical equipment. Nine patients (26.7%) received staged therapy, with an average of a 5.4-day delay (range 3 ~ 9 days) due to open fracture or extreme swelling of soft tissue (external skeletal fixation first, then shifted to an internal fixator). Prophylactic antibiotics with first-generation cephalosporin, cefazolin, were administered intravenously in all patients and were prescribed as necessary for at least the first day. Other than the routine prophylactic antibiotics, the patients with open fracture may have received a combined aminoglycoside, gentamycin, and the agents were subsequently replaced according to the culture results.

Surgery was performed under general or spinal anesthesia. Patients were set up in the supine position on the operating table, with a knee flexion of 15° ~ 30°. A tourniquet was used to diminish blood loss and was deflated for no more than 2 h. During the operation, the fracture reduction was visualized via an image intensifier, and arthrotomy was always performed to check the congruity of the articular surface. Temporary fixation with Kirschner wire or an interfragmentary screw was a helpful technique, and bone substitute or allogeneous bone grafts were applied to elevate the osseous gaps. A Hemo-Vac drain tube was placed in the operation wound, and the wound was closed primarily.

All patients were followed up according to the postoperative protocol shown below. In the initial 6 weeks postoperatively, patients were educated to avoid weight bearing, and in the following 6 weeks, partial weight-bearing ambulation with a walking frame was prescribed. Full weight-bearing walking was then allowed once solid union was observed on plain film. We arranged periodic follow-ups at 6-week intervals to take radiographs and record clinical function.

Three criteria were used to be sure about union on plain films: (1) Bridging callus between fragments, (2) Obliteration of previous fracture gap, and (3) No further displacement of fracture fragment including articular surface after full weight-bearing ambulation during serial follow-up images. The standard anteroposterior (AP) Radiographs of the injured knee should be obtained immediately postoperatively and at the time of fracture healing by two experienced observers. A positive value was applied to angles representing a valgus deformity, while negative values were applied to a varus deformity. According to previous clinical articles, malunion with malreduction or malalignment is defined as change of alignment of (1) intra-articular step-off over 2 mm or (2) angulation over 5° in AP or lateral view radiographs. The chi-square test was used for comparison of categorical variables between the two groups and a *p* value lower than 0.05 was accepted as statistically significant in all analyses

Results

66 patients were reviewed with PTF, Schatzker types V and VI, who we operated from June 2012 to May 2015 in our institute. Excluding patients who expired due to other medical conditions and without complete follow-up, 34 patients were sorted out in this series. The scheme of surgical intervention was designed by visiting staff, and 15 patients, as group I, were treated with unilateral locking plate. The other 19 patients, as group II, were treated with classic dual plates (one lateral approach locking compression plate (LCP)+medial anti-gliding plate) No significant differences existed regarding gender ratio, mean age, injured limb, and mechanism of trauma between the two groups. The descriptive data of these patients are summarized in Table 1.

Table 1: The descriptive data of these patients are summarized

Case number	15	19
Male/female ratio	7/8	12/7
Mean age (years) (range)	49.1 ± 13.4 (18 ~ 83)	53.6 ± 14.8 (18 ~ 76)
Injured limb (right/left)	9/6	10/9
Trauma mechanism (TA/fall)	14/3	14/3
Schatzker classification (V/VI)	8/7	11/8

Table 2: Reports the perioperative parameters and main functional outcomes. The listed data were available for all 45 patients during surgery, the period of hospitalization, and the serial follow- ups after discharge. There were statistically significant differences in perioperative parameters, including the duration of surgery, the period of hospitalization, and whether a staged management was needed between the two groups.

	Group I (ULP) N=15	GROUP II (BLP) N=19
Operation time (min)	76.6 ± 14.73 (50 ~ 145)	101.4 ± 18.23 (60 ~
Blood loss (ml)	69.3 ± 14.36 (30 ~ 180)	± 24.31 (~ 250)
Hospitalization period (days)	9.3 ± 4.27 (5 ~26)	15.6 ± 8.71 (7~ 51)
Union ratea	78.9% (11/15)	86.7% (17/19)
Funct. Outcom E	34.1 ± 4.91 (6~ 61)	36.5 ± 5.88 (7~ 66)
PAIN 0-20	5.4 ± 2.31 (0 ~12)	4.9 ± 2.06 (0 ~13)
Stiffness 0-8	4.8 ± 1.68 (0 ~7)	4.3 ±1.21 (0 ~6)
Physical function 0-68	24.9 ± 4.82 (4~ 49)	26.3 ± 5.74 (4~ 50)

Overall, three patients (11%) faced non-union after 1 year of follow- up, and the average union rate was between 78% and 91% in the two groups. Comparisons of the functional outcome, using the WOMAC score, disclosed better physical function with bilateral plating. e mean WOMAC score was 34.6 (range 6 ~ 66), and the mean score for pain, stiffness, and physical function was 4.97 (range 0 ~ 13), 4.41 (range 0 ~ 7), and 25.2 (range 3~ 50), respectively.

We recorded several kinds of complications in this study i.e Infection, Knee stiffness (<90° flexion), Posttraumatic Arthritis, Malunion, Non- Union, Hardware Impingement,

Re-fracture, and Implant failure. No significant differences existed regarding the above items, with the exception of the ratio of hardware impingement, which required a secondary operation to remove the implants. All patients with infection were managed with local wound care and oral antibiotics, but three cases developed deep infections, which were treated with repeat irrigation, debridement, intravenous antibiotics, and follow- up at the Infection Clinic.

1. Illustrative cases of Group I, treated with unilateral locking plate (ULP)



Fig A: 42 yr old female presented with bicondylar fracture tibia following an automobile accident and was managed with lateral locking plate.



Fig B: 65 yr male with bicondylar tibia fracture after involving in RTA



Fig C: 57 yr male fall from height

Illustrative cases of group II, treated with classic dual plates Fig-a: 44 yr male following a RTA**Fig-b:** 63 yr male tibia fracture managed with bicondylar plate fixation**Fig c:** 38 yr male tibia fracture managed with dual plate and c.c screw fixation**Fig d:** 52 yr female following a fall from height managed with dual plate fixation**Discussion**

TPFs were classified using the Schatzker classification system, which distinguishes low- energy split/depression fractures from higher energy bicondylar fractures (Schatzker type V/VI). For most surgeons, bicondylar TPFs remain an arduous challenge because the knee is a biomechanically complex joint and these fracture patterns are often combined with trauma to the surrounding soft tissue [3]. To achieve the most satisfactory outcome, a well-designed preoperative surgical strategy with minimal unnecessary soft tissue injury must be designed. Over the past years, a number of treatment modalities have been developed, such as simple skin traction, cast immobilization, external skeletal fixation, and open reduction and internal fixation with different implants. In this article, conventional 3.5-mm buttress plates, dynamic compression plates (DCPs), 1/3 tubular plates for anti-gliding, and pre-contour periarticular locking compression plates (LCPs) were applied for fixation. The goals of operative treatment for TPFs were anatomic

reduction, especially in restoration of articular congruity, stable fixation for early rehabilitation, and avoidance of complications, particularly infection and non-union. In our study, we included a series of 45 bicondylar TPFs, Schatzker type V or VI, which were all followed up for at least 18 months. We found a significantly different ratio of Schatzker type V/VI between Group II (CDP) Barei *et al* [4], and Ali *et al* [5]. reported that single lateral locked plating may not be as effective as dual plating in managing bicondylar tibial plateau fractures, and lots of previous studies have demonstrated a postoperative malreduction rate of 15% ~ 23% using the LISS plating system Barei *et al* [4]. reported 83 AO/OTA type-41-C3 bicondylar TPFs treated with medial and lateral plate fixation through two exposures. They concluded that medial and lateral plate stabilization of comminuted bicondylar TPFs through medial and lateral surgical approaches is a useful treatment method to achieve well functional outcome though some cases still have residual dysfunction.

Our study was comparing conventional dual plates with unilateral locking plates and showed similar functional outcome when compared with a locking plate [6]. Restoration of mechanical stability with reliable fixation methods leads to early rehabilitation, a greater range of motion, and an acceptable union rate, which result in a better functional outcome. Overall, we had an incidence of deep infection of 5.3% ~ 9.1%, malunion of 9.1% ~ 20%, and a non-union rate of 9.1%–21.1%, which were similar results to previous studies. Regarding posttraumatic arthritis of 9.1% ~ 20%, the average follow-up period was 13.6 months in our study and may need more time to analyze the impact of this fracture episode to posttraumatic arthritis.

Conclusion

Our study shows Dual plating provides better stability and outcome than unilateral plate fixation for Schatzker type V and type VI fractures. Based on our clinical follow-up, several key points should be emphasized:

1. Soft tissue problems should be always kept in mind, and usage of a locking plate can reduce the discomfort of hardware impingement effectively.
2. The single lateral approach technique for TPF with a pre-contour locking plate reduces the soft tissue dissection, operation time, and hospitalization period.
3. If the medial buttress cannot be established by reduction of the lateral fracture, then open reduction of the medial side is necessary, and the medial fragment should be buttressed with a dual plate.
4. A trend of a higher postoperative malalignment rate over the posterior-medial compartment was noted in group I, but more cases and further evaluation are needed for

verification.

5. CT scan is an essential tool in preoperative planning of bicondylar fractures

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