MEDIAl BUTTRESS VERSUS LATERAl LOCKED PLATING IN A MEDIAl TIBIAL PLATEAU FRACTURE MODEL

INTRODUCTION: Traditionally bicondylar tibial plateau fractures have been treated with both medial and lateral compression plates. However, the surgical approach is extensive which can result in skin breakdown and soft tissue irritation. Compression of the plates onto the bone can result in osteolysis and loss of fixation which is also a concern. An alternative approach suggested to eliminate some of these problems is the use of a lateral locking compression plate (LCP)⁷. In order to evaluate the medial plateau component of a bicondylar fracture, an isolated medial plateau fracture was created in a cadaver model to test the hypothesis that the lateral LCP would be equivalent to the medial buttress dynamic compression plate (DCP) in both static and cyclic loading.

METHODS: Six matched pairs of fresh cadaveric tibias were stripped of their soft tissues. In all tibias, a medial plateau fracture was simulated by creating a cut that was 20 degrees to the long axis of the tibia beginning just medial to the intercondylar eminence. One of each pair was repaired using a 6 hole medial DCP plate (Fig 1A). The other tibia was repaired with a 6 hole lateral LCP plate (Fig 1B). To provide uniform compressive loading of the medial articular surface, a low melting point alloy was positioned onto the plate. Before the alloy hardened, a steel ball was centrally placed (Fig. 1C). Specimens were cyclically loaded for 1000 cycles at 2 Hz from 40 to 670 N. The maximum cyclic displacement that occurred during the 1000 cycles of motion as well as the residual displacement after the 1000 cycles was measured. Specimens were then loaded to failure at a rate of 0.5 mm/sec, and the force and maximal displacement at failure were measured. Clinical failure was defined as 1 cm of actuator displacement. Post failure radiographs were obtained to evaluate displacement and mechanism of failure. A paired t-test was used to compare the two plating techniques.

RESULTS: Cyclic testing revealed that neither the maximum cyclic nor residual displacement were statistically different between the two fixation techniques. However, it should be noted that there was nearly 2 mm of displacement during cyclic loading with the lateral LCP (Table I). In static testing, failure occurred at over 4000 N for the medial DCP but at least 3000 N for the lateral plate (p<0.05)(Table II). Total displacement at failure was not significantly different. Both medial and lateral plates failed due to either a split in the medial fragment itself or the fragment crushing under axial loading. There was no identifiable failure of the plates or screws.

DISCUSSION: In testing to failure, the medial plateau fragment failed with less force when stabilized by the lateral LCP than when compared to the medial DCP. During normal gait, the physiologic force across the medial compartment of the knee can exceed 1500 N. Two of six specimens fixed with lateral plates failed at 1240 and 1555 N, near or below the forces seen with normal gait. There was also a trend showing that the medial buttress plate is more stable than the lateral LCP during cyclic loading. Although these results were not statistically significant, the 2 mm of displacement seen during cyclic testing may be clinically significant, as this amount of displacement of the articular surface has been associated with an inferior outcome. These displacements occurred during a load normally seen across the medial knee during the swing phase of gait. Both plates failed due to fragment fracture or cut-out.

Sevral limitations must be considered. The force necessary for ultimate failure in 10 of 12 specimens was above the force typically generated through the medial plateau during physiologic loading. Furthermore, the effect of interval healing of the fracture could not be evaluated with this model. Therefore, this study may over state the limitations of these fixation techniques. The specimens used in this study were from aged subjects, and bone densities were not performed. Consequently, these results cannot be extrapolated to young patients with high energy injuries. Only isolated simple split medial tibial plateau fractures were tested in this study, thereby avoiding additional instability due to comminution or a bicondylar component. In the latter clinical scenarios, the implants tested would likely not perform as well as in this simplified model.

CONCLUSIONS: This study has shown that in a medial tibial plateau fracture without comminution, the medial buttress DCP provides greater stability in static loading to failure, and there is also a trend towards improved stability with cyclic loading. The lateral locked plate may not adequately maintain stabilization of the medial plateau fracture component. In the clinical setting of a bicondylar tibial plateau fracture, one should still consider a medial DCP to support the medial plateau.


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