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ORIGINAL ARTICLE

# Biomechanical comparison of plate-screw and screw fixation in medial tibial plateau fractures (Schatzker 4). A model study

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**KEYWORDS**
Medial tibial plateau fractures;
Bone model;
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**Summary**
*Introduction:* The objective of this biomechanical study was to compare the respective efficiency of plate-screw fixation and screw fixation in an experimental model of a Schatzker type 4 fracture. Hypothesis: screw fixation and plate fixation have a similar load to failure.
*Materials and methods:* This study compares the stability of Schatzker type 4 medial tibial plateau fractures fixed with either 36.5 mm cancellous bone screw with a 16 mm threaded segment or with six-holed buttress T-plate-screw system. A Schatzker type 4 fracture was modeled on an artificial bone model. In a first group of 10 fracture models, following the anatomical reduction, fractures were stabilized with screws with washers. In the second group, of 10 fracture models, fractures were stabilized with T-plate. After fixation ascending axial compression was applied on bone models (Instron machine).
*Results:* Load bearing capacity was $1397.6 \pm 194.4$ N in the Group 1 and $2153.2 \pm 204.4$ N in the Group 2. The difference between the two groups was statistically significant ($p < 0.001$).
*Discussion:* According to this result, experimental load bearing of bone models indicate that plate-screw fixation system has a significantly higher stabilization capacity than fixation with three screws alone. Our hypothesis was not confirmed. In order to maintain anatomical repositioning, plate-screw system is a more stable fixation method than the screw in medial tibial plateau fractures Schatzker 4
Level of evidence: 1.


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## Introduction

Fractures of tibial plateau are intraarticular fractures that require anatomic reduction and stable fixation to prevent the development of osteoarthritis in the late postoperative period [1]. Although, numerous cases of lateral tibial plateau fractures have been reported in the literature, there is limited data concerning fractures of medial tibial plateau. Various methods ranging from conservative treatment to diverse surgical techniques have been described and their long-term outcomes have been published throughout the historical development of treatment for lateral plateau fractures [2]. Recently, favorable outcomes have been reported following minimally invasive arthroscopy-assisted closed reduction and percutaneous screw fixation of the lateral tibial plateau fractures [1]. Minimal invasive methods offer fast postoperative recovery in addition to reduced risk of infection. Limited studies published recommend open reduction and fixation with plate-screws for the treatment of medial plateau fractures.

## Hypothesis

We hypothesized screw fixation provides sufficient stability in medial tibial plateau fractures as in lateral plateau fractures; we thus compare the biomechanical properties of plate-screw osteosynthesis and screw osteosynthesis in a bone model.

## Materials and methods

A cortical/cancellous type artificial bone (Synbone, Switzerland) was used as the bone model. Synbone type 1111 used in this experimental study is a cortical-hard cancellous bone model with a tibial plateau width of 74 mm and diaphyseal diameter of 27 mm.

Medial plateau fracture (Schatzker type 4 fracture) was simulated in the bone model (Fig. 1). An oblique cut starting from 5 cm distal to the joint line of the medial tibial plateau was extended to the medial of tibial tubercle. Fragment created by this cut had a triangular shape. Reduction of the fracture was accomplished by clamps and provisional K-wires.

Following reduction, two groups were formed to compare two methods. Ten fractures in the first group were fixed by three 6.5 mm cancellous screws with 16 mm partial threads. Distance between the proximal screws was 2 cm and


**Figure 1** Tibia bone model used for the study.

**Figure 2** Fixation with three 6.5 mm cancellous screws.

screws were inserted 1 cm distal to the joint. Third screw was inserted to the apex of the triangular fragment (Fig. 2).

Fractures of the remaining ten bone models in the second group were stabilized by a six-hole T-plate with three cancellous screws placed to the proximal and four cortical screws placed distal to the fracture line (Fig. 3).

After fixation bone model was cut at a level 17 cm distal to medial plateau and a circular external fixator consisted of two rings was applied to adapt the bone model to the Instron 8516 device (Fig. 3). Two K-wires placed 12 cm distal and one K-wire placed 16.5 cm distal to medial tibial plateau were fixed to rings under tension. Bone model with circular external fixator was mounted on the test device.

Bones were loaded by a tension, compression and fatigue test device (Brand and model: Instron 8516), which provided 100 kN dynamic/124 kN static maximum loading capacity (Fig. 4). Compression test was used for the present study. Unilateral load was applied on the central part of medial

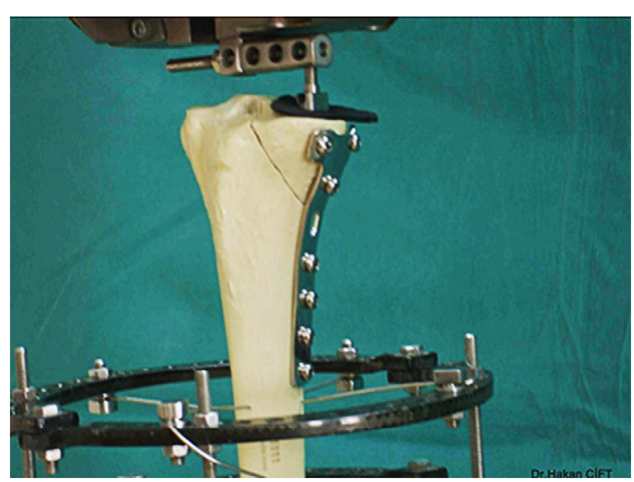


**Figure 3** Image of the fracture line stabilized by plate and screws.