



## Lateral tibial plateau fractures with posterior comminution. Can a rim plate offer sufficient support?

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**Tibial plateau fractures with posterior comminution are difficult to reduce and stabilise. Standard lateral approach doesn't offer adequate visualisation. Posterior approach is suitable for isolated posterior fractures. The addition of a specifically contoured rim plate can enable fixation of posterior fragments through a modified lateral approach. The purpose of this study was to evaluate the advantages and limitations of this novel technique. We present a prospective series of 16 tibial plateau fractures with posterolateral depression, operated over a period of 7 years (04.2014-09.2021). The mean age of the patients was 52 years. They were followed for an average period of one year. Clinical and functional assessment was performed according to the criteria of Knee Society Clinical Rating Score. The lateral and posterior component of the fracture was stabilised by a horizontal rim plate, through a posterolateral approach, with or without fibular osteotomy. 9 patients had excellent, 5 had good, 2 had average ratings. The average objective rating was 87,5 (70-97), and the average functional rating was - 74,4 (40-100). The average ROM was 110° (100°-120°). Two of the fractures healed in 5° varus and 8° valgus respectively. One knee joint ended up with 10° flexion deficit. Three knees had medio-lateral instability, with no functional impairment. In 4 cases the K wires of the weber fibular osteotomy fixation migrated. The absence of late articular collapse of the treated fractures may be attributed to the initial stability of fixation. The addition of a rim plate addresses the posterior comminution and makes early rehabilitation safe.**

**Keywords:** tibial plateau, posterior comminution, rim plate, mid term results.

### INTRODUCTION

Tibial plateau fractures with posterior comminution present a surgical challenge. They can be difficult to diagnose, difficult to get to, difficult to reduce and to fix. At the same time posterior comminution is not so rare. Krause quotes up to 75% combined anterior and posterior involvement in 246 tibial plateau fractures<sup>1</sup>. Standard lateral approach doesn't offer adequate visualisation of the posterior aspect of the tibial plateau. In a comparative study, Salomon et al. reported only 25% anatomical reductions achieved via an anterolateral approach<sup>2</sup>. Frosch considered the fibular head and the structures of the popliteal corner as the primary obstacle<sup>3</sup>.

Direct posterior approach has an obvious advantage when treating a rare isolated posterior plateau fracture. The patient has to be prone on the operating table. Unfortunately, in most of the cases, some combination of approaches is needed. Turning and redraping of the patient prolongs the operating time.

The addition of a specifically contoured rim plate can enable fixation of posterior fragments through a modified lateral approach, without turning of the patient<sup>4</sup>. We adopted this novel technique. The purpose of our study was to evaluate its advantages and limitations.

### MATERIALS AND METHODS

We present a prospective series of 16 tibial plateau fractures with posterolateral depression, operated for a period of 7 years (04.2014-09.2021). Six of the fractures involved the lateral portion of the proximal tibia (type B according to the AO/ASID classification), while the rest were bicondylar (type C) (figure 1 A) . Fracture distribution is presented in table I.

Seven of the patients were female, nine were male. The average age was 52 years (ranging 25-60 years).

X ray and clinical examination was performed monthly till the sixth postoperative month. The average follow up was 1 year.

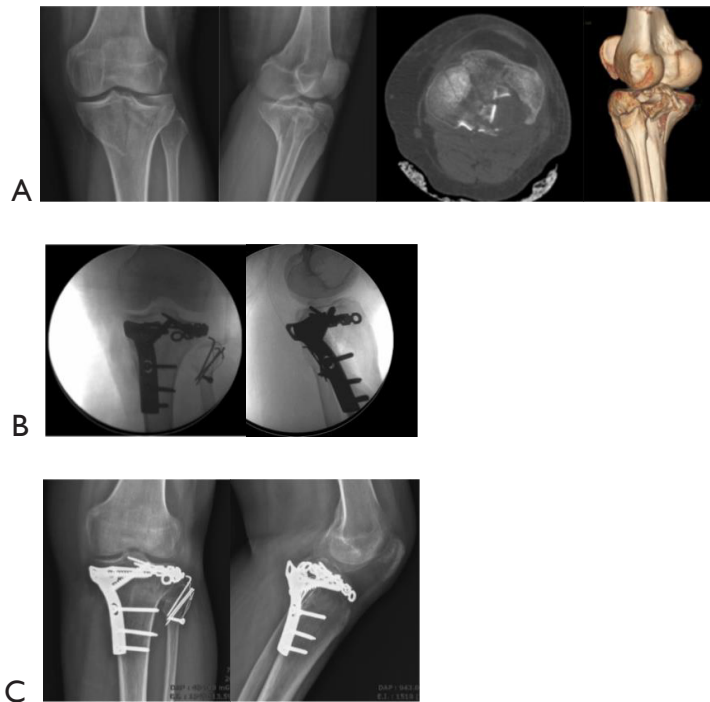


Figure 1. — A. 60 years old overweight female, low energy trauma, AO/ASIF type 41 C 3.1. B. Intraoperative images. Buttress plating of medial condyle, rim plate of the lateral condyle fracture, fibular head osteotomy fixation. C. United fracture, no articular collapse on twelfth postoperative month, K-wire migration.

**Table I.** — Fracture distribution according to AO/ASIF classification.

AO/ASIF	41 B2	41 B3	41 C3
N	1	5	10

Clinical and functional assessment was performed according to the criteria of Knee Society Clinical Rating Score. Two hundred points were awarded in 2 categories: objective assessment (pain, stability, range of movement) and functional rating (walking, climbing stairs).

Radiological evaluation was performed according to Rasmussen’s criteria. Articular depression, condylar widening and axial alignment were measured and graded. Anatomically reduced fracture received an excellent grade. Articular depression and condylar widening of less than 5 mm and axial malalignment of less than 10° equalled a good score.

*Surgical technique*

The patient was positioned supine on a fracture table. An incision was centered over the bicipital tendon proximally and curved over to the anterior

muscle compartment distally. The perineal nerve was dissected and protected. External fixator was applied to achieve distraction and axial alignment in 4 cases. Fibular osteotomy was performed in majority of the cases (n=12) (figure 1 B). After a standard submeniscal arthrotomy the lateral meniscus was inspected. Eight menisci were found torn. All were repaired, by direct peripheral suture. No menisci were resected. The fracture was then reduced under direct visual control. Bone grafting was performed in all cases. No bone graft substitutes were used. A non-locking, small fragment set, reconstruction plate was molded to match the shape of the lateral condyle. In most cases (n=12) an additional buttress plate was added for metaphyseal support (figure 2 B). If damaged, medial plateau was addressed through a separate posteromedial approach and fixed with another buttress plate (n=10). Fibular reinsertion was done by a compression screw (n=5) or using Weber’s technique (n=7) (figure 1 B). All limbs were immobilised in full extension until the postoperative pain subsided. After a mean period of one week, immobilisation was discontinued and passive assisted exercises on CPM machine started. Partial weight bearing was postponed till the second postoperative month. Full weight bearing was allowed one month later.

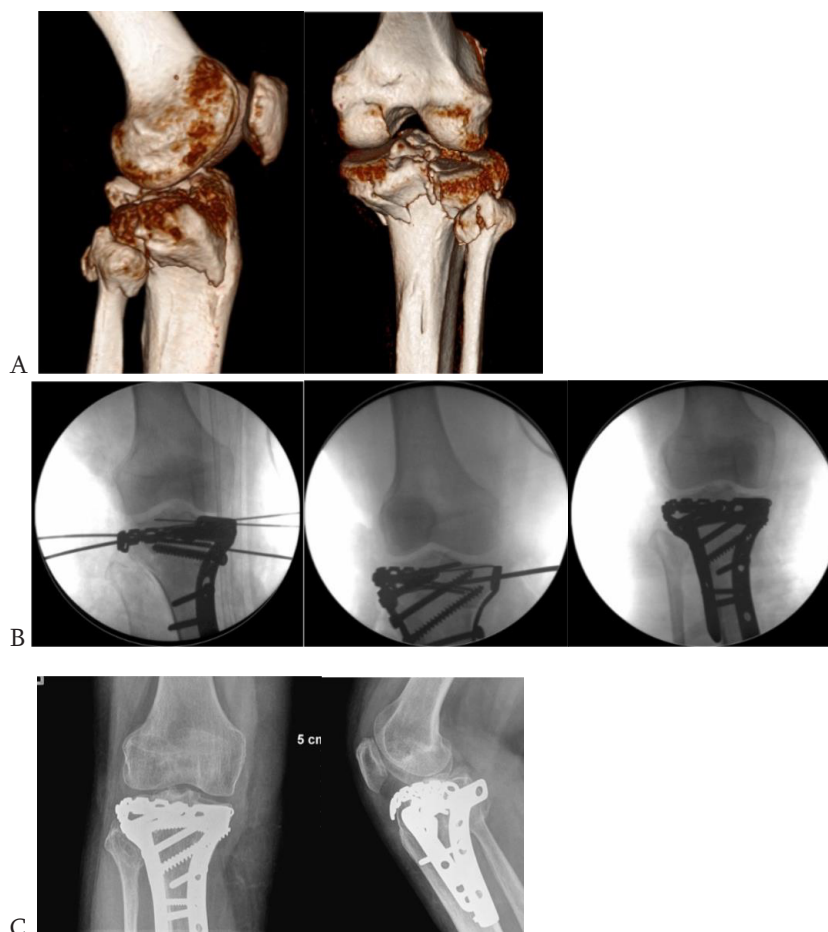


Figure 2. — A. 40 year old woman, low energy trauma, AO/ASIF Type 41 C 3.3 tibial plateau fracture with posterior displacement. Comminuted fibular head fracture. B. Intraoperative images. Rim plating after partial fibular head resection without an osteotomy. Medial and lateral buttress plate fixation. C. United fracture, no articular collapse on twelfth postoperative month.

## RESULTS

All 16 fractures united for a mean period of 13,75 weeks (12-16 weeks).

According to the criteria of the Knee Society Clinical Rating Score, 9 patients had excellent, 5 had good, 2 had average ratings. The average objective rating was 87,5 (70-97), and the average functional rating was 74,4 (40-100). The average ROM was 110° (100°-120°).

On the final follow up 12 patients were painless, 2 had slight and the rest had sporadic pain. Five patients could walk less than a kilometer. Because of the short mean follow up, we could not assess late functional impairments, as well as arthritic changes.

Ten of the x-ray results were graded as excellent, while the rest 6 received a good score according to the Rasmussen's criteria. Not a single case of late articular

collapse was noted (figure 1 C). A summary of the results and complications is presented on table II.

## COMPLICATIONS

We didn't record any serious intraoperative complications, DVT, or septic arthritis. There was one marginal skin necrosis that was debrided and healed under second intention. No peroneal nerve was damaged. Two of the fractures healed in 5° varus and 8° valgus respectively. No corrective surgeries were performed. One knee joint ended up with 10° extension deficit.

Three knees had medio-lateral instability, with no or slight functional impairment. No extra knee surgeries were deemed necessary.

In 4 cases, the K wires of the fibular osteotomy migrated.

**Table II.** — Final functional results and complications.

Fracture type AO/ASIF	Knee society clinical rating score	Follow up	Rasmussen rating	Healing time (weeks)	Complications	Fibular osteotomy/ fixation
41C3	Average	1 year	Good	16	8° valgus, 10° extension deficit, K-wire migration	Yes/weber
41C3	Good	1 year	Excellent	12	Medio-lateral instability	Yes/screw
41 B3	Good	2 years	Excellent	12	Medio-lateral instability	Yes/screw
41 B1	Excellent	4 years	Excellent	12		Yes/weber
41B3	Excellent	2 years	Excellent	12	Marginal skin necrosis	Yes/weber
41C3	Good	1 year	Good	16	K-wire migration, medio-lateral instability	Yes/weber
41C3	Excellent	6 months	Excellent	12	Medio-lateral instability	Yes/screw
41B3	Excellent	6 months	Excellent	16		Yes/weber
41B3	Excellent	1 year	Excellent	12		No
41C3	Good	6 months	Good	16	K-wire migration	Yes/weber
41B3	Excellent	8 months	Excellent	12		No
41C3	Excellent	6 months	Good	16		Yes/screw
41C3	Excellent	6 months	Excellent	12		Yes/screw
41C3	Average	6 months	Good	16	K-wire migration	Yes/weber
41C3	Excellent	6 months	Excellent	12		No
41C3	Good	6 months	Good	16	5° varus	No

**DISCUSSION**

The ideal fracture treatment method should combine optimal visualisation, anatomical reduction and stable fixation. Direct posterior approach and buttress plating is missing an alternative in isolated posterior plateau fractures. In reality they are quite rare. Krause et al. found they comprise just 5,9% of the type C included in their study. Most of the time there was a combination of posterior and anterior fragmentation 94,1%<sup>1</sup>. In those cases using direct posterior approach isn't sufficient. Patient has to be turned from prone to supine position, in order to approach the anterior portion of the fracture thus prolonging the operation time. Another problem is the limited posterior safe space for buttress plating, as well as the challenging surgical dissection<sup>5</sup>. The alternative postero-lateral approach, with or without fibular head osteotomy, offers good visualisation of the fracture and allows adequate control of the reduction<sup>6</sup>. The patient is supine on the operation table. Unfortunately buttress plating of the posterior fragments isn't possible. Addition of a rim plate can address this shortcoming. It is molded around the condyle. Multiple small diameter screw can be strategically placed to support the fragments. Over contouring can produce some degree of compression<sup>7</sup>. Although biomechanically inferior to buttress plating, the implant can offer sufficient support.

In our series we routinely immobilised the knee joint in full extension for a short period of time. Movement was initiated, typically within a week, when pain subsided. Despite this early rehabilitation, none of the 16 fractures displaced postoperatively. Fibular osteotomy fixation caused most of the complications. K wires migrated in 25% of the cases. Unrecognised comminution of the fibular head was the most common reason. This prevented fixation of the osteotomy with a compressive screw. Fortunately all osteotomies healed uneventfully, but functional recovery was impeded. K wire migration was present in all of our average rated patients. Later in the series, we avoided fibular osteotomy, utilising partial fibular head resection (figure 2) as described by Yu et al.<sup>8</sup>.

Another difficulty that we encountered was the restoration of tractus iliotibialis at the end of the procedure. The tibial insertion was often traumatically ruptured or detached in the course of the surgical dissection. This could explain the high percentage of varus instability (18% of the cases) in our series. Later in the study we adopted the osteoplastic detachment technique, originally described by Tscherne-Johnson<sup>9</sup>. Instead of elevation of the iliotibial band, the authors advised osteotomy of the lateral cortex along the Gerdy's tubercle. This allowed for both unimpeded fracture reduction and secure tractus restoration at the end of the procedure.

The overall results of our study are quite favourable. Most of the patients ended getting excellent or good functional ratings.

The addition of a rim plate extended the spectrum of fracture variants that could be addressed through a postero-lateral approach. The stability of fixation was sufficient for early rehabilitation. Although rim plate fixation is biomechanically suboptimal, it can be used in appropriate indications.

*Disclosure summary:* The author has nothing to disclose.

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