Case Report

Successful Treatment of Closed Fracture Schatzker Type V: A Case Report

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Abstract

Background
Schatzker V tibial plateau fractures are complicated intra-articular fractures caused by high energy trauma. They are often accompanied by severe soft tissue injury, collapse of the articular surface, tibial condyle separation and other complications. However good therapeutic effects can often be achieved. Therefore, we selected a typical case worthy of a detailed presentation.

Case Summary
A 45-year-old woman was hit by a moving car and reached the hospital emergency room two hours later, mainly having pain, restricted movement and swelling of the limbs on her right-hand side. X-ray indicated that the fractures occurred shortly after impact at affected sites, these included but we're not limited to: multiple right rib fractures, comminuted tibial plateau fractures. We confirmed the fracture of the tibial plateau by Computed Tomography 3D reconstruction. Then we used the anterolateral- and the posterolateral approach with double incisions. Two plates were implanted for internal fixation, and the patient's clinical status improved after the operation. The postoperative function was evaluated after 3 and 11 months after the accident and 2 months after screws and plates were retrieved. Finally the patient recovered more rapidly than expected.

Conclusion
The Schatzker V fracture of the tibial plateau is a type of serious fracture, which deserves the prompt intervention of orthopedic trauma surgeons, alongside a multidisciplinary team of clinicians, in due course. This case report includes the anatomy, pathophysiology, diagnosis and the decision making process of operative treatment and may provide guidelines for orthopedic.

Key Words: Fracture of Tibial Plateau; Schatzker Type V; Reconstruction Plates; Case Report

Introduction
The case chosen for this diagnostic exercise pertains to the orthopedic trauma realm. However, like in every emergency context, it is essential not only to diagnose promptly and accurately the type and nature of the injury, but also to assess the most recent and previous history of the patient. This involves the ruling in and out of systemic conditions

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as well as eventual local issues relevant to the damaged area, especially when a variety options, conservative or interventional, are on the table. This, inherently, points toward specific operative choices and informs the orthopedics, who are quintessentially surgeons, as per what type of operation they must perform (as well as the anesthetist, the nurses and all the other professionals involved in the recovery post operation, such as the physiotherapist) to obtain optimum results for the patient, while bearing in mind the patient's characteristics, needs and wishes.

Given the age of the patient, skeletally mature at the time of the accident, the clear pathophysiology of her closed Schatzker Type V fracture and the fact that there were no neurovascular complications involved before, during or after the operation, perhaps the need for a more detailed clinical discussion has been preempted. However:

- It was interesting to delve into the wealth of information concerning possible abnormalities of the tibial plateau, its fracture, tibial varus or valgus deformities and other conditions that would have been considered essential in other contexts; therefore the differential diagnosis discussion has been formulated in a kind of check list to be ruled out in the light of the need of an operation to fix the trauma.

- The actual discussion concerning the operation planning is reported here in full, as it is part and parcel of the therapy options available, in relation to the type and character of the fracture and selection process, the outcome of which was then executed on the operating table.

- The operative log is herein documented with visual materials and simple technical descriptions; this is to:

  o Show how the damage assessment and interventional decision making continue as a dynamic flow throughout the operation, with each step being tackled according to the necessity, rather than a surgical plan being decided upon and then executed to the letter.

  o Better illustrate how the patient came to heal completely 3 months ahead of the expected 12 months since the one-stop-operation. The plates and screws have been removed promptly thereafter.

**Case Presentation**

**Anonymized Patient Details**

Age: 45 years  
Gender: female  
Status: married  
Ethnicity: han  

Presented to: Department of Orthopedics & Traumatology, Shanghai East Hospital South Campus in April 2017

**Chief Complaint**

Patient involved in a road collision with a car; impact to the patient’s right-hand side with multiple parts being damaged, causing pain, limited activity and swelling.

**History of Complaint**

Road collision taken place 2 hours prior to arrival at Emergency Department.

Patient was hit by a moving car.

Visibly impacted sites and initial x-ray:

- Right chest pain & reduced activity  
- Right back pain & reduced activity  
- Knee pain & swollen

o Comminuted fracture of:

  - right proximal tibia  
  - right proximal fibula

o Right distal tibial fracture

- Right calf swollen  
- Ankle pain & swollen  
- Heel hematoma

In both lower limbs there was no sign of abnormality and the feeling was normal.

Normal color and function of lower limbs.

No abdominal pain or distention.

No nausea and/or vomiting.

No chest tightness.

Normal urination and no sign of incontinence/anuria/hematuria.

Unresolved bowel movement.

Since the accident the patient has not lost consciousness and is of clear and sound mind.
Patient History

The patient’s history is unremarkable and she denies history of:

- Hypertension
- Diabetes
- Coronary heart disease
- Chronic bronchitis
- Infectious diseases, such as:
  - Hepatitis
  - TB
  - HIV
  - Other
- Major trauma
- Previous surgery
- Transfusion
- Allergies to food or medication
  - Penicillin
  - Other
- Contact with:
  - Waterborne disease
  - Epidemic areas of any kind
- Domestic abuse

Patient confirms:

- Vaccination status matching with legal requirements in China
- Valid antitetanic status

Patient and tests exclude a pregnancy.

Physical Examination

Temperature: 36.8°C
Pressure: 135/79 mmHg
Heart Rate: 78 p/m
Respiratory rate: 16 p/m

Unremarkable vitals, in spite of the list of traumas indicated above.

Final Diagnosis

The definitive diagnosis using the appropriate classifications according to:

- Hohl & Moore classification type 5
  - Bicondylar
  - Both tibial plateaus are split off. The distinguishing feature is that the metaphysis and diaphysis retain continuity. Both condyles can be fixed with buttress plates and cancellous screws. Avoid stabilizing condyles with large bulky implants. In a review of their experience with tibial plateau fractures, Moore, Patzakis, and Harvey found 296 bicondylar fractures in a study group of 988 plateau fractures. Of these bicondylar fractures, 95 were treated by ORIF and only 11 required medial and lateral plating. Nine (82%) of the fractures treated with medial and lateral plating underwent dehiscence or became infected. In addition, 23% of type V bicondylar fractures became infected. The less involved condyle can be stabilized with a small antiglide plate placed at the apex of the fracture with minimal softtissue dissection, our preferred method[1].

- Schatzker classification Schatzker V
  - Continuity of metaphysis and diaphysis

  - Four-part fracture. Constituting 10% of all fracture dislocations, this injury is nearly always unstable. Neurovascular injury occurs in 50% of fractures; the popliteal artery and the peroneal nerve are injured in more than one third. Both collateral ligament complexes are disrupted with the bicondylar fracture, and the stabilization provided by the cruciates is lost because the intercondylar eminence is a separate fragment. Although a bicondylar approach has been recommended, others have been more cautious, recommending plating of the more comminuted plateau and lag screw fixation of the more intact condyle. Realizing the high incidence of infection and dehiscence with bicondylar plating and the extensive exposure necessary, a method of lateral plateau plating with temporary medial external fixation was described by Mast. We have used limited open reduction and percutaneous fixation with neutral external fixation by pin fixators in a delta configuration or an Ilizarov external fixator. As with Schatzker type V bicondylar fractures, extreme care must be taken with soft tissues. Motion is not allowed until the skin has healed. Weight bearing is delayed according to the method of fixation; with Ilizarov fixation, early weight bearing is allowed to tolerance[2].

- AO classification 41-C3 PL, PM, AM
  - Sagittal view:
    - Complete articular and multifragmentary fracture
    - Axial view:
      - Postero-lateral
• Postero-medial  
• Antero-medial  

![Figure 1: Pre-operative 3D reconstruction of CT scan with fractured blocks highlighted](image-url)

**Treatment**

The treatment goals for a tibial plateau fracture are: [3]

- Decompression and preservation of soft tissue  
- Reconstruction of joint surfaces  
- Reconstruction of normal mechanical axis  
- Early mobilization

There are several options available, depending on the characteristics of the fracture and the general condition of the patient[4].

- Non-operative treatment
  
o Indicated for:
  
  - No joint step >2mm  
  - No axial instability  
  - Severe osteoporosis  
  - General and/or local contraindications  
  - Elderly patients

  o Methods:
  
  - Traction for a short period  
  - Early active movements in cast brace  
  - Touch foot weight-bearing if patient's condition allows  
  - Weight-bearing to tolerance at 6 weeks  
  - Operative treatment

- Operative treatment
  
o Emergency, rare
  
  o Indicated for:
    
    - Popliteal artery injury  
    - Compartment syndrome  
    - Gross dislocation  
    - Floating knee  
    - Polytrauma  
    - Open fracture

  o Delayed treatment to allow soft tissue recovery and adequate investigations

For the operative treatment options, there are different approaches:[5]

- Anterolateral  
- Posteromedial  
- Lateral  
- Mini-open

Treatment options have to be evaluated carefully considering the morphology of the fracture:

- Is there a need for bone graft OR bone substitute Y/N  
- What methods and which type of components need to be deployed to achieve stabilization?

  o Distractor  
  o Screws  
  o Plate/s  
  o Hybrid fixator

- Suitable for severe soft tissue injuries  
- Reconstruction of joint surface  
- Reconstruction of stable axes  
- Early motion  
- Excellent results

  o Joint fixation
     
     - Locked internal fixation  
     - Locking head screws provide better support than conventional screws in a short metaphyseal fragment  
     - Percutaneous insertion preserves soft tissue  
     - LISS-PLT of metaphysis in addition to:
       
       - Reduction of joint  
       - Fixation using lag screws  
       - Restoration of mechanical axis
Decision Making: Operational Intervention & Therapies

The two most important questions in this specific case are:

- How to fix the posterolateral mass?
- How to fix the posteromedial and anteromedial masses?

![Anterolateral block](image1)

The best treatment option is the use of locking plates for tibial plateau fractures, while keeping in mind the characteristics of Chinese patients:

- Laterally one single plate
- Anteromedially steel plate + auxiliary rear anti-slide plate
- Posteromedially medial plate

In this case, these are the approaches for the lateral bone block fixation:

- Anterolateral approach
- Anterolateral approach plus posterolateral approach

The Czech posteromedial tibial plateau plate is constituted by 1 unlocked steel plate and two lock angle stabilizers.

The Johnson posteromedial bone platform plate entails 2 proximal screws and does not suffice fixing the posteromedial section of the plateau. Besides, it is very difficult to form and hold together 3 plates of steel. For this reason this option is ruled out.

There is a need for a posteromedial anti slide plate, but without using 3 separate plates, as they would add too much material and less stability to the proximal tibia overall.

Therefore the choice falls on to a plate that allows the use of 5 nails, 2 lock screws and 3 slide holes, to block the posterior fragment of the plateau.

![Chosen plate which makes the block of the posterior plateau fragment possible](image2)

Once the locking elements are selected, the right approach is the next aspect to be considered carefully. The aim is to keep the number of incisions to a minimum and still maximize the results. The plan is to use two incisions maximally:

- an anterolateral approach
- a posterolateral approach

The combination of the two incisions on the skin needs to be performed not just according to the technical needs, but also having in mind the esthetic result as well as the age and gender of the patient.

Inter-Operative Log

One incision is made on the posterior side of the anatomic complex.

It is suitable for lateral fractures without the simple reduction and fixation of the lateral incision.

Then the traditional anterolateral approach is applied. All the following steps have been documented photographically.

Figure 4: Exposed posterolateral fracture block

Figure 5: Reduction of posterolateral bone block

Figure 6: Medial incision of the knee joint

Figure 7: Exposure of the medial bone mass

Figure 8: Temporary fixation with Kirschner wire to reduce bone block

Figure 9: Posteromedial plate insertion

**Figure 10:** Reduction of lateral bone mass

**Figure 11:** Kirschner pin fixation

**Figure 12:** Lateral bone block fixation

**Figure 13:** Medial plate being positioned and fixated

**Figure 14:** Lateral tibial plateau bone graft

**Figure 15:** Insertion of the lateral plate
Outcome and Follow-Up

The surgical treatment appeared to be successful without complications. The postoperative function was evaluated 3 and 11 months after the accident and also 2 months after screws and plates were retrieved.

Discussions

Anatomy of the Knee & Tibial Plateau

The knee is the largest synovial joint in the human body and is operating like a hinge joint. It can be divided into 3 compartments:

- Patellofemoral articulation with 2 elements sliding into opposite directions:
  - Patella
  - Patellar groove
- Medial articulation
- Lateral tibiofemoral articulation, both linking upper and lower leg:
  - Femur
  - Tibia + Fibula

The knee is bathed and so-to-speak “oiled” by the synovial fluid within the synovial membrane or joint capsule.

The medial and lateral articular bodies, called condyles, make sliding and rolling movements possible.
The knee also consists of:

- Bursae
- Cartilages
- Menisci
- Ligaments

The tibial plateau is in the proximal part of the tibia and is consisting of:

- Medial condyle
- Inter-condyloid eminence

Lateral condyle

The connection between the tibial plateau and other anatomical structures in the proximal section of the knee is rather complex, especially in relation to ligaments, nerves, arteries, veins and the fascia defining the compartments of different muscles. It is understandable that many types of knee trauma can cause damage to the surrounding structures, with the potential of different complications to take place. Among them are:
Pathophysiology & Classification of Tibial Plateau Fractures

It has been widely accepted that fractures of the tibial plateau can be caused by various forces:[10]

- Valgus/varus deformation
- Axial compression
- Flexion/extension
- Direct trauma

There are several mechanics involved in the fracturing process. The force that compresses the femur condyle/s against the medial and/or lateral condyle/s of the tibia inferior to it, induces a lasting depression of the lateral condyle/s due to the fracturing portion/s of the plateau. The fracture is either along vertical or oblique lines and with or without the involvement of the tibial collateral ligament. The proximal fibula is also involved in this process.

At both ends of the age spectrum there are mainly two subgroups:

- Young patients with stable bones usually require a high-energy trauma to suffer from a fracture. These fracture types most often entail:
  - Extensive damage to the soft tissue
  - Contusions
  - Open injuries
  - Compartment syndrome
  - Peroneal/tibial nerve involvement
  - Popliteal artery involvement

- Elderly patients with osteoporosis or other diseases affecting the bones often just require a low-energy impact to get a fracture. These types involve:
  - Axial trauma
  - Axis deviation
  - Fixation problems

Investigations which are usually needed for a final diagnosis are:

- CT scan on 3 planes:
  - Anteroposterior
  - Lateral
  - Oblique
- MRI
- Angiography

To classify the fracture type more easily it is advisable to answer the following questions:

- Soft tissue damage Y/N
- Osteoporosis Y/N
- Nerve damage Y/N
- Vessel damage Y/N
- Degree of:
  - dislocation
  - comminution
  - joint involvement

There are several classifications that can be used:
The AO classification of proximal tibial fractures (41-) is as follows:

- **A** extra-articular
  - A1 avulsion
  - A2 metaphyseal simple
  - A3 metaphyseal multifragmentary

- **B** partial articular
  - B1 pure split
  - B2 pure depression
  - B3 split-depression

- **C** complete articular
  - C1 articular simple, metaphyseal simple
  - C2 articular simple, metaphyseal multifragmentary
  - C3 articular multifragmentary

To complete the AO classification, there is an axial quadrants classification as follows:

- **Type I** pure articular fracture
  - I1 primary articular fracture
  - I2 primary articular fracture with metaphyseal involvement

- **Type II** metaphyseal fracture with primary articular lesion
  - II1 primary articular fracture with metaphyseal involvement
  - II2 primary articular fracture with metaphyseal involvement

- **Type III** primary articular fracture with secondary metaphyseal fracture
  - III1 primary articular fracture with secondary metaphyseal fracture
  - III2 primary articular fracture with secondary metaphyseal fracture

- **Type IV** primary articular fracture with secondary metaphyseal fracture
  - IV1 primary articular fracture with secondary metaphyseal fracture
  - IV2 primary articular fracture with secondary metaphyseal fracture

- **Type V** primary articular fracture with secondary metaphyseal fracture
  - V1 primary articular fracture with secondary metaphyseal fracture
  - V2 primary articular fracture with secondary metaphyseal fracture

Differential Diagnosis & Discussion

The patient is 45 years old, therefore skeletally mature and does not belong to the two main subgroups at either end of the age spectrum. She has, however, sustained a road collision, involving exclusively her right side of the body, from thorax to foot. The damaged areas present fractures as follows, detectable soon after the impact:

- Right multiple rib fractures
- Right tibial plateau fracture
- Right distal tibial fracture
- Right fibular head fracture
- Right medial malleolus fracture
- Right heel skin contusion

The patient rules out any previous issue with the right knee and evidence supports that the knee was normal until the road collision (mirroring the left knee, which is still intact and normal even after the impact); there have not been any issues from infancy to young adulthood, such as: [15]
• Blount’s disease
• Trauma
• Infection
• Family history of knee abnormalities
• Obesity
• Osteochondrosis dissecans
• Osteoarthritis
• Tendonitis
• Physiological genu varus/valgus
• Growth plate fracture
• History of medial knee pain
• Medial proximal tibial tenderness
• Leg length discrepancy
• Clumsiness with walking and gross motor skills

Osteoporosis is also to be ruled out due to the patient age and the evidence.

The dynamic of the fracture is not clear, however from the appearance of the fracture itself, it is easy to assume that a combination of forces may have contributed to the resulting damage. In fact the right tibial plateau fracture, comprising the distal right fibular fracture, does not involve damage to neurovascular structures or a compartment syndrome; the details that have been captured in the X-ray and explored further by CT and CT-reconstruction scans are:

![Figure 28: Pre-operative X-ray](image)

![Figure 29: Pre-operative CT scan 3D reconstructions of patient's proximal tibia and fibula](image)

Post-Operative Therapy & Physiotherapy

The patient needs to rest and recuperate after the operation. At the same time she needs to mobilize her knee (and all other skeletal areas damaged in the accident) and make use of it as soon as possible.

Analgesia is necessary, initially with on-demand morphine and then via oral medication.

![Figure 30: Postoperative function 11 months after the operation](image)
The patient is prescribed a few months of physiotherapy under the supervision of professionals at the hospital where she was operated.

The result appears to be successful and without complications.

**Conclusion**

The Schatzker V fracture of the tibial plateau is a serious fracture type and requires a highly professional treatment by orthopedic trauma doctors and other medical staff. By using the right diagnostic methods and operative approach good results can be achieved.

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**References**


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14. Personal notes taken by Nazzarena Arman from lecture by Prof Yunfeng Yang, Tongji Hospital, 2018.04.20