Scholastic Orthopaedics
Case Report
Volume 1 Issue 1- 2025

The Complexity of Tibial Wedge Fractures Differentiating Unicortical and Bicortical Patterns – A Case Report

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Received: January 17, 2025; **Published:** February 11, 2025

Abstract

Fractures of long bones with comminution, particularly those involving butterfly or wedge fragments, pose significant challenges in surgical planning and management. This report presents the case of a 27-year-old male with a tibial plateau fracture and a bicortical tibial wedge fracture resulting from a road traffic accident. Initially, the wedge fragment was misidentified as unicortical, leading to intraoperative challenges that required a reassessment of the fracture morphology. This case underscores the importance of detailed preoperative imaging in fracture evaluation and highlights the need for accurate differentiation between unicortical and bicortical wedge fragments to guide appropriate surgical strategies. Fixation was successfully achieved using screws for the tibial plateau and interlocking nails for the tibial shaft. The outcome demonstrates the critical role of precise imaging and intraoperative decision-making in managing complex tibial fractures.

Introduction

Tibial shaft fractures are common in the United States, with nonunion rates reported between 5% and 15%. The economic burden of nonunion is substantial, with costs estimated to be up to USD 14,000 higher than those for healing fractures. These challenges have driven significant research aimed at identifying predictive factors for nonunion and developing effective surgical approaches [1].

A specific fracture pattern, the butterfly fragment, often results from complex forces such as torsion and multi-directional bending. However, despite understanding its mechanisms, the relationship between the presence of extraarticular butterfly fragments and delayed or impaired tibial healing is not yet fully clarified [2].

The Winquist classification system, introduced in 1980, stratifies femoral shaft fractures by the degree of bone fragmentation, which aids in deciding whether to employ intramedullary nails or proceed with open reduction. Here's how it breaks down: (**figure 1**)

- Type 0 involves either no fragmentation or a very minor butterfly fragment that is less than a quarter of the bone's width.
- Type I has a butterfly fragment that is smaller than a quarter of the bone's width.
- Type II features a butterfly fragment that is half or less than half of the bone's width.
- Type III is characterized by a significant butterfly fragment that exceeds half of the bone's width.
- Type IV is marked by extreme fragmentation, where an entire bone segment is comminuted.

Types I and II are indicative of fragmented fractures that may include a butterfly segment with a relatively minor area of cortical bone. This segment is typically not fixed during intramedullary fixation and is expected to heal without issues. However, when there is more extensive cortical bone fragmentation, there's an increased risk of complications such as angular misalignment, limb length discrepancy, and failure to heal properly. Type III fractures involve butterfly segments that make up more than half of the bone's width and include a particular variety known as ring butterfly fragments. These are particularly problematic as they heighten the risk for improper alignment and failure to heal [3].

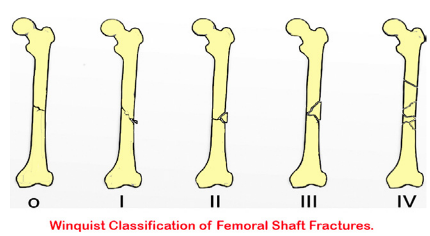

Figure 1: Illustration of the Winquist classification of femoral shaft fractures. *Image contributed by Dr. Samir Benoudina, Radiopaedia.org, rID: 48181.* For more information, refer to the original case: Benoudina S, Winquist classification of femoral shaft fractures. Case study, Radiopaedia.org. DOI: https://doi.org/10.53347/rID-48181

The 2018 revision of the AO/OTA Fracture and Dislocation Classification Compendium provides updated guidance on classifying fractures in adults and children, refining earlier approaches. According to the revised classification, tibial shaft fractures are categorized into three main types: Simple (Type A), Wedge (Type B), and Multifragmentary (Type C). Multifragmentary fractures are further subclassified into intact segmental fractures (Type C2) and fragmentary segmental fractures (Type C3) [4].

The fracture in this case does not align perfectly with these established classifications, as it involves characteristics of both wedge and segmental patterns. While AO/OTA terminology does not include the term "segmental wedge," this fracture exhibits unique features, with a segment that encircles the full circumference of the medullary canal. This overlap highlights the potential limitations of current classification systems in addressing such atypical fracture patterns.

When managing fractures with significant segmental comminution, achieving proper alignment in two dimensions is critical to successful fixation. Surgeons must carefully evaluate the anatomy of the involved fragment, which encompasses much of the medullary canal, and rely on high-quality preoperative imaging to understand the fracture's complexities fully [5].

Case Presentation

A 27-year-old male presented to the emergency department following a road traffic accident.On arrival, the patient was hemodynamically stable and was found to have an isolated left lower limb injury.On examination, there was right leg swelling, limited range of motion due to pain, tenderness to palpation and the skin was abraded with ecchymoses. There was no distal neurovascular deficit with dorsalis pedis, tibialis posterior pulsations were well felt, and the sensation was intact.

Radiographs showed tibial plateau fracture and a both-bone leg fracture, specifically a wedge-type fracture of the tibial shaft (figure 2) . The fractured limb was initially protected with back slap . Given the complexity of the injuries, the patient was admitted for surgical intervention. The treatment plan included the fixation of the tibial plateau fracture with screws and addressing the midshaft tibial fracture with an interlocking nail.

Figure 2: preoperative X ray of the knee with leg showing tibial plateau and wedge shaft fracture.

Upon admission, the patient underwent a comprehensive evaluation. Informed consent was obtained, detailing the surgical procedure, potential risks, and expected outcomes. The patient's understanding and agreement were confirmed before proceeding.

The patient was placed in the supine position under spinal anesthesia, and the leg was prepped and draped in a standard fashion.The tibial plateau fracture was addressed first. the fracture was meticulously reduced by percutaneously placed reduction clamps. Subsequently, two cancellous screws (6.5mm) with washers were employed for stable fixation.(figure 3).

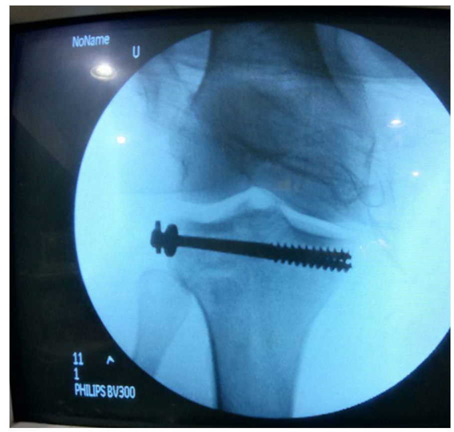

Figure 3: Intraoperative fluoroscopy image of the knee showing fixation of tibial plateau fracture by 2 cancellous screws.

Attention then turned to the midshaft tibial fracture. A longitudinal incision over the patellar tendon. The entry point for the interlocking nail was determined with precision under fluoroscopic guidance. A solid awl was used to open the bone, and a guide wire was introduced, aligning with the center of the medullary canal.

Initially assuming the tibial wedge fracture to be unicortical, a trial of closed reduction and wire advancement was attempted, but it proved insufficient.

It was well positioned inside the medullary cavity of the major fragments in both antero-posterior and lateral views, but the triangular comminuted fragment which was originally considered a unicortical butterfly fragment had now displaced antero-medially. This displacement made possible its correct identification as a typical table ring fracture. The wire had passed behind the ring fragment displacing it and preventing its subsequent reduction. (figure 4).

Figure 4: Intraoperative fluoroscopy image of the leg showing displacement of butterfly fragment after passing of wire posterior to it.

Oblique views, facilitated by fluoroscopy, revealed the true bicortical nature of the wedge fragment. Adapting the approach, the guide wire was withdrawn, and manipulation of the wedge fragment ensued using a K-wire as a joystick.The guide wire was then inserted through this fragment, advanced to the distal segment, and

employed for further reduction. (figure 5) Reaming followed, preparing the medullary canal for nail insertion, which was secured with locking screws.

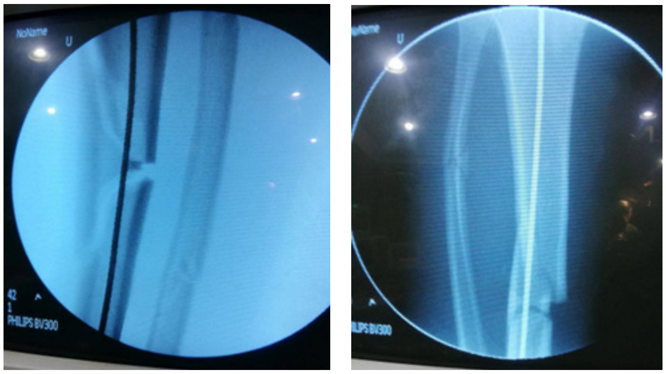

Figure 5: Intraoperative fluoroscopy image of the leg after reducing butterfly fragment and passing guide wire.

Throughout the operation, strict attention was paid to fluoroscopic guidance, ensuring accuracy in fracture reduction and hardware placement. The utilization of oblique views during the procedure played a pivotal role in unveiling the true morphology of the tibial wedge fracture, leading to the necessary adjustments for successful fixation. (figure 6).

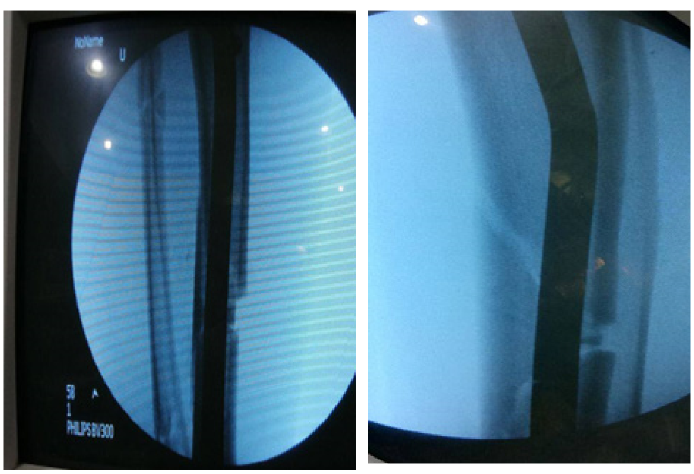

Figure 6: Intraoperative fluoroscopy image showing reduction of fracture and fixation by intramedullary nail.

Postoperatively Patients underwent a two-week follow-up wound check and examination for pain or stiffness requiring physiotherapy,demonstrating evidence of fracture union. He regained the ability to bear weight and eventually returned to his pre-injury activity level. (figure 7)

Figure 7: Follow up X-ray leg showing fracture reduced and secured by nail.

Discussion

This case underscores the critical need to identify the table ring fracture pattern, which can involve a considerable section of the intramedullary canal. Although this type of segmental wedge fragment may not be easily detected on standard radiographs, it can complicate surgical reduction efforts, as seen when a guide wire fails to align properly, causing additional displacement during its advancement into the distal bone segment.

When initial radiographs are inconclusive, oblique views can provide surgeons with crucial detail in planning closed intramedullary nailing procedures. It is essential for surgeons to be alert to the possibility of a table ring fracture pattern in early radiographic assessments.

Additional imaging, such as CT scans, can confirm this fracture type prior to surgery, ensuring that the guide wire follows the medullary canal path through the segmental wedge fragment and re-establishes the fracture's anatomical structure.

If the table ring fracture pattern is not identified during preoperative imaging, intraoperative challenges may suggest its presence. Signals include difficulties in guiding the wire through the medullary canal and an increased risk of fragment displacement upon rod insertion. In this case, an initial reduction challenge necessitated guide wire removal and repositioning of the wedge fragment using a K-wire as a joystick. Unidentified segmental wedge fractures also raise the possibility of soft-tissue injury during reaming and rod placement, further displacement of fragments, and an increased risk of malunion or nonunion.

We recommend incorporating the table ring fracture pattern as a unique classification type. This fracture type, with its distinct clinical features, requires the use of oblique imaging during preoperative planning and should be reduced before guide wire insertion to achieve precise alignment and stabilization.

Conclusions

This case report highlights the essential role of thorough preoperative planning and the value of oblique radiographs in revealing the detailed nature of table ring fractures. Initially, the wedge fragment was incorrectly identified as unicortical; however, an intraoperative reassessment allowed for a necessary adjustment in surgical strategy.

Both preoperative and intraoperative oblique radiographs were instrumental in accurately assessing the fracture's structure.

Additionally, our discussion on categorizing the wedge segmental fracture as a new classification type underscores the importance of continuously improving our understanding of fracture patterns. The distinct characteristics and treatment challenges of this fracture type, as shown in this case, support its inclusion in classification systems to aid in surgical planning.

In summary, the positive outcome—demonstrated by fracture healing and the patient's return to normal activity—emphasizes the importance of flexibility and precision in managing complex tibial wedge fractures. This case contributes valuable insights to the orthopedic field, encouraging ongoing diligence in assessing and treating similar fractures.

References

1. Tian R, Zheng F, Zhao W, et al. (2020) "Prevalence and influencing factors of nonunion in patients with tibial fracture: systematic review and meta-analysis". *J Orthop Surg Res*; 15(1): 377.

2. Myhre L, Steffenson L, et al; (2023) "Butterfly fragments in diaphyseal tibial fractures heal unpredictably: Should we be adopting other strategies for these high risk fractures? Injury". Feb; 54(2): 738-743.

3. Winquist RA, Hansen ST Jr. (1980) "Comminuted fractures of the femoral shaft treated by intramedullary nailing". *Orthop Clin North Am*. Jul;11(3): 633-648.

4. Meinberg EG, et al; (2018) "Fracture and Dislocation Classification Compendium-2018". *J Orthop Trauma*; 32(Suppl 1): S1-S170.

5. Gutowski C, Abrams JS, Gutowski WT. (2013) "Diagnosing segmental wedge fracture of the tibia before performing intramedullary nailing". *Am J Orthop* (Belle Mead NJ). Aug; 42(8): 369-371.