A Single-Center Retrospective Study of the Injury-Force Mechanism in 169 Tibial Plateau Fractures: Importance of the Rotational Component in Flexion-Valgus Trauma

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Purpose: The aim of this study was to provide an analysis of injury-force mechanisms in tibial plateau fractures (TPFs), including axial rotation. Moreover, we hypothesized that, especially in flexion-valgus trauma, concomitant soft-tissue injury not only occurs bicondylarly according to the diagonal line principle, but also unicondylarly by rotation.

Methods: We retrospectively assessed 202 TPFs that occurred over a period of 37 months. Demographic data were collected and the injury-force mechanism was determined for the 169 TPFs that met inclusion criteria. Fractures were classified as flexion-varus/valgus/neutral or extension-varus/valgus/neutral by observing the articular depression area on CT/MRI. Subsequently, fractures were subclassified into rotation-neutral, internal- or external-rotation according to the Gerdy tibial tuberosity surgical epicondylar axis angle. Soft-tissue injury was documented if MRI was performed. In addition, follow-up imaging of all flexion-valgus fractures was reviewed for signs of failure.

Results: Of the 169 TPFs classified, 37 (21.9%) were caused by a flexion-valgus force. At least 20 of these suffered to some extend signs of failure (ie, progressive femorotibial valgization, secondary posterolateral depression, or lateral tibial plateau widening). Extension-valgus was the most common mechanism (n = 79, 46.7%). Extension-varus was seen in 21 fractures (12.4%) and extension-neutral in 17 (10.1%). The least common mechanisms were flexion-varus and flexion-neutral, seen in 9 fractures (5.3%) and 6 (3.6%), respectively. Axial rotation was present in 78 fractures (46.2%). Specifically in flexion-valgus fractures, external rotation was present in 29.7% and internal rotation in 24.3% of cases. However, a Kruskal-Wallis test revealed no significant difference in rotation between injury-force groups [$H(5) = 7.025$, $P = 0.219$]. Only 20 (11.8%) of the 169 classified fractures underwent MRI. 11 of these were flexion-valgus type traumas, all revealing soft-tissue injury. In 10 cases this involved some degree of posterolateral corner (PLC) injury. Rotated fractures seemed to be associated with more severe PLC injury (ie, higher numbers of damaged structures) compared to non-rotated fractures.

Conclusion: Our results highlight the importance of axial rotation, especially in flexion-valgus trauma, and imply that tension not only occurs in the anteromedial, but also in the posterolateral corner. This causes additional soft-tissue injury and, if unaddressed, might lead to higher posterolateral loading and increased chance of failure. Applying the injury-force mechanism and addressing rotational forces will, together with preoperative MRI and intraoperative stability assessment, help the surgeon determine the need to address associated soft-tissue injury.