

What is the Rate and Degree of Torsional Deformity in Femoral Nonunions? A CT-based Retrospective Cohort Study

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INTRODUCTION: Nonunions are severe complications following femoral shaft fractures and are often associated with mechanical instability. Correcting deformities is a critical aspect of treatment, as deformities can lead to impaired physical function and long-term sequelae such as osteoarthritis. Rotational deformities, specifically, may be frequently underdiagnosed due to the inconsistent use of bilateral CT scans prior to revision. This study investigated the rate and degree of rotational deformities in femoral nonunions.

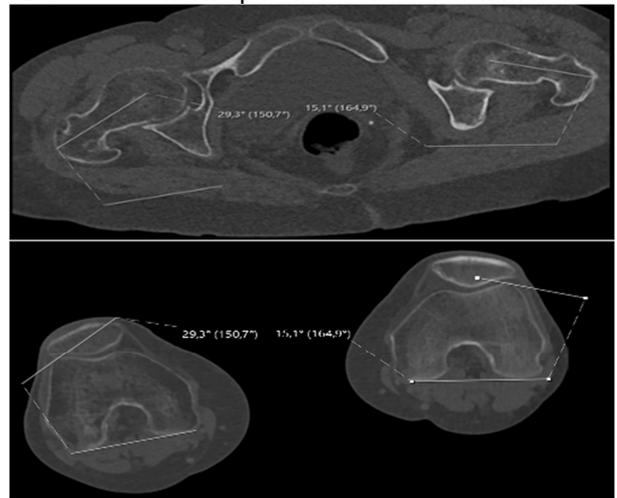
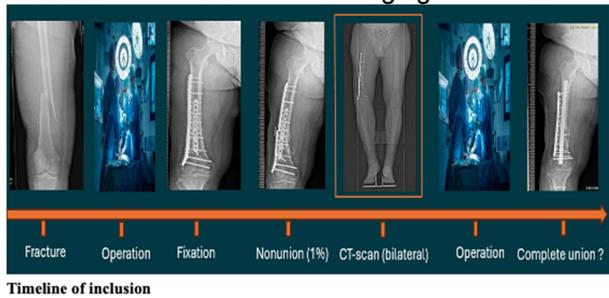
METHODS:

We retrospectively identified patients from a single Level 1 Trauma center between 2015 and 2024 who underwent operative treatment for femoral shaft nonunion and had a preoperative CT scan of the bilateral femurs. Patients with hip or knee prostheses, previous fractures in the contralateral limb, cancer-related fractures or osteotomy-related nonunions were excluded. The primary outcome was the rate and degree of rotational deformity and was determined by the angle between a line drawn across the femoral neck and the distal femoral condyles of both femurs. A difference of 15 degrees or more was considered as clinically relevant. Three independent reviewers determined rotational deformity and the average of the three measurements was used in the results; in addition, the intraclass correlation coefficient (ICC) was calculated to assess the agreement between the measurements

RESULTS:

Thirty-eight patients were included. The median age was 55 years (IQR 31–68) and 68% of patients were male. The median BMI was 27.8 kg/m² (IQR 25–30). Most nonunions stemmed from initial high-energy injuries (71%) and classified as AO/OTA type B (47%) or C (34%). The median time from injury to nonunion surgery was 18.4 months (IQR 10–22). Twenty patients (53%) had a torsion deformity of ≥10°, with 12 patients (32%) showing a clinically relevant rotation deformity of ≥15°. 47% type B and 34% type C. No significant correlation was found between AO classification and the degree torsional deformity (*p* = 0.766). The rate of clinically relevant deformity was 24% in the group presenting with IMN and 8% in the group treated with plate fixation (*p* = 0.876). In the group of patients with torsional deformities of ≥10°, there was a non-significant difference in the rate of rotational deformity between patients treated with IMN (29%) (mean rank 12.64) and those treated with plate fixation (24%) (mean rank 7.89; *U* = 26.0, *p* = 0.074). The direction of deformity (internal vs. external rotation) was not significantly skewed (*p* = 0.143). Interobserver reliability for axial femoral torsion measurements was excellent, with ICCs of 0.96 (affected limb) and 0.94 (unaffected limb), supporting high consistency among raters.

DISCUSSION AND CONCLUSION: Rotational deformities are common in femoral shaft nonunions, with over half of patients demonstrating a difference of ≥10° and one-third exceeding the clinically relevant threshold of >15°. Although no statistically significant associations are found between fixation type, fracture classification, or deformity direction, patients treated with an intramedullary nail may be at a greater risk for deformity. These findings support the routine use of bilateral CT imaging in the work-up of femoral nonunions.



Axial measurements (difference in torsional degree: 29,3 – 15,1 = 14,2°)