

## Reliability of the Modified Radiographic Union Score for Tibia Fractures (mRUST) in Femoral Shaft Fractures

*Gregory Joseph Schmidt, MD; David P. Foley, MBA; Austin Samuel Simpson, BS; Luke A. Lopas, MD; Yohan Jang, DO; Todd Owen McKinley, MD; Brian Mullis, MD  
Indiana University, Indianapolis, Indiana, UNITED STATES*

**Purpose:** The Modified Radiographic Union Score for Tibia Fractures (mRUST) is a widely used method of evaluating fracture healing that has been validated in both tibia and metaphyseal distal femur fractures. While the process of callus formation and fracture consolidation is radiographically similar after treatment with intramedullary nail (IMN) between tibia and femur shaft fractures, the validity of mRUST for femur shaft fractures after IMN has not been documented.

**Methods:** A retrospective review of all tibia and femur fractures treated with an IMN from 2013 to 2018 at a single Level I trauma center was performed. Patients aged 18 to 55 years with a tibia shaft fracture or femur shaft fracture treated with IMNs were eligible for inclusion. Exclusion criteria included pathologic fractures, planned revision for bone grafting, and subacute presentation. In total, this study included 1253 tibia and 1338 femur sets (AP and lateral views) of postoperative radiographs in 330 patients with tibia shaft fractures and 354 patients with femur shaft fractures. Radiographs were evaluated by 3 fellowship-trained orthopaedic traumatologists and 3 orthopaedics trainees with an mRUST score given to all radiographs. All raters then read a random selection of 630 femur and 273 tibia radiograph sets a second time. Inter- and intraobserver reliability were assessed using both the Krippendorff's Alpha (KA) and Intraclass Correlation Coefficient (ICC).

**Results:** The overall interobserver KA for the tibia shaft fractures was 0.94 (ICC 0.97), and KA for the femur shaft fractures was 0.93 (0.96). Among fellowship-trained evaluators, KA for femur fractures was 0.91 (0.94), and it was 0.88 (0.92) among trainees. In tibia fractures, fellowship-trained faculty showed a KA of 0.91 (0.93), and KA was 0.92 (0.96) for trainees. The pooled intraobserver KA for femur fractures was 0.90 (0.98) and 0.91 (0.98) with tibia fractures. The intraobserver reliability of femur fractures was 0.89 (0.97) among faculty and 0.90 (0.96) for trainees. Similarly, intraobserver reliability in tibia fractures was 0.91 (0.98) in experienced surgeons and 0.93 (0.98) for trainees.

**Conclusion:** These results preliminarily support the use of mRUST for evaluation of radiographic healing progression in femur shaft fractures treated with IMNs. As in tibia shaft fractures, the intra- and interobserver reliability of mRUST for femur shaft fractures was found to be high. Additionally, mRUST appears to be reliable when utilized by trainees in addition to experienced surgeons for evaluation of tibia and femur shaft fractures treated by IMNs.