

Early Functional Performance Is a Valid Predictor of Outcome After Tibia Fracture*Peter Augat, PhD¹; Janina A. Muessig, MS (PhD Student)¹;**Andreas Brand, MS (PhD Student)¹; Inga Kroeger, BSc¹; Robert Paetzold, MD¹**¹Institute of Biomechanics, Trauma Center Murnau, Murnau, Bavaria, GERMANY*

Purpose: Healing after fracture is typically assessed by conventional radiographic imaging. However, radiographs are an ambiguous indicator for healing and for functional performance. Evaluation of gait has been suggested as an early predictor of healing outcome. This prospective case series was conducted to test the hypothesis that early assessment of functional weight bearing after tibial shaft fractures predicts healing outcome at 12 months after fracture.

Methods: In a prospective case series, 20 patients with tibia/fibula shaft fractures (42-A and 42-B) who were surgically treated with an intramedullary nail were included and 15 (11 male, 33 ± 12 years; 4 female, 47 ± 19 years) have completed the 12-month follow-up. Patients' functional loading on the affected leg was measured 12 weeks post surgery during knee-bending on a force plate. Walking was quantitatively assessed in an instrumented gait laboratory. Analysis was focused on kinematics about the knee measured in the frontal plane. Healing outcome was assessed by Short Musculoskeletal Function Assessment questionnaire (SMFA) and the Radiographic Union Scale for Tibial Fractures (RUST).

Results: Functional loading at 12 weeks was a good predictor for functional performance ($R = -0.73$, $P = 0.001$) and everyday activity ($R = -0.60$, $P = 0.01$) at 12 months. Four patients had reduced weight bearing at 12 weeks (34% vs 53%, $P < 0.001$) and demonstrated unphysiological loading of the knee joint with increased valgus moment and reduced knee flexion ($P < 0.01$). Radiographs at 12 weeks demonstrated incomplete healing in 14 of 15 patients with an average RUST score of 7 ± 2 . At the final follow-up at 12 months after surgery, the 4 patients with reduced loading at 12 weeks had a significantly reduced function score (18 ± 7 vs 7 ± 5 , $P < 0.01$) and everyday activity score (19 ± 13 vs 5 ± 5 , $P < 0.01$). In contrast, the RUST score at 12 weeks was not associated with any of the outcome parameters at 12 months after fracture ($P > 0.2$).

Conclusion: Our findings suggest that functional loading of a fractured limb at 12 weeks after injury is highly predictive of the healing outcome at 1 year. Patients unable to place at least 50% body weight on their affected leg 12 weeks after surgery remain to have limitations in their function and everyday activity until up to 12 months after their accident. Gait analysis suggests these functional limitations to be associated with gait imperfections and unphysiologic loading. In conclusion, functional analyses could help in early identification of functional deficits, and could potentially indicate therapeutic intervention to prevent functional deficits.