Gait Analysis Following Intramedullary Nailing of Midshaft Femur Fractures: How Surgical Approach Affects Early Post-operative Gait Patterns

Michael M Hadeed, John Mead, Emily Dooley, Shawn Russel, David Weiss, Seth Yarboro

Introduction: Surgical approach for intramedullary nailing of midshaft femur fractures is often surgeon dependent. Early comparative studies noted an increase in hip pain after the antegrade approach and an increase in knee pain after the retrograde approach. Healing rates are similar between the two approaches. The purpose of this study was to (1) determine if intramedullary nailing after midshaft femur fractures altered gait mechanics, (2) determine how long after surgery the gait patterns returned to normal, and (3) determine whether the gait changes were different based on surgical approach.

Methods: Consecutive patients at a level 1 trauma center were screened for this prospective study between 2018 and 2020. Inclusion criteria were age >18 and a midshaft femur fracture that could be treated with either a retrograde or antegrade femoral nail (as decided by the treating surgeon). Exclusion criteria were any fracture extension proximal or distal which would dictate a specific approach or concomitant injuries which would be expected to affect gait patterns. Gait analysis was completed at regular intervals (2, 6, 12, 26 weeks). Subjects were recorded using 3D motion capture and five force plates. Walking trials were collected on a 15m walkway at a self-selected walking speed. A minimum of six trials were analyzed for each subject at each time point. The Plug-in-Gait model was used to calculate joint kinematics and kinetics, then exported to Matlab for analysis.

Results: Gait kinematics were altered compared to normal controls in the post-operative period after intramedullary nailing for femoral shaft fractures. Antegrade patients showed significantly less deviation from the control group compared to retrograde patients. Gait patterns returned to near normal at the six-month timepoint. There was no difference in the rate of normalization. There were key differences to the gait kinematics depending on the surgical approach used. Retrograde patients had reduced knee flexion during early stance, an increased knee abduction moment, a decreased knee extension moment, and a decreased hip extension moment. The decreased flexion and extension of the injured knee combined with the decreased hip extension moment indicate that the patients walked with a straighter injured leg, leading to the increased knee abduction moment. Antegrade patients displayed a decrease in hip abduction moment and hip adduction angle.

Conclusions: This pilot data indicated that the approach for femoral nailing of midshaft femur fractures did affect early-postoperative gait mechanics. The retrograde cohort had significantly more deviation from a normal gait post-operatively. This may be important as surgeons strive to

return patients to previous levels of function expeditiously in the post-operative period. More data is needed to draw conclusions which may affect clinical practice.