Determining a Timeline for Returning to Drive After Experiencing a Right Femoral Extremity Fracture Using a Braking Simulator

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INTRODUCTION:

Depending on the fracture severity, anatomy, fixation methodology, soft-tissue damage, and recovery time, lower right extremity fracture patients are recommended to refrain from driving for 2-12 weeks. This restriction can impede the quality of life for patients during recovery. Although the available, scarce literature about the time to return to driving accounts for lower limb anatomical fracture regions, there are no specific guidelines for each location (femur, tibia, fibula, or foot fractures). By utilizing a braking simulator to precisely assess the postoperative (post-op) brake reaction time and force, this study aims to specifically determine when patients with right femoral fractures are ready to return to driving.

METHODS:

After IRB approval, 100 patients who were licensed drivers with right femoral fractures were recruited in this study and categorized based on the fracture pattern and surgical fixation method. Patients were assessed using a custom-developed braking simulator (Figure 1) during their post-op clinical follow-up visit. Patients were asked to perform three trials of driving-to-emergency stop simulations in which brake reaction time and force were measured. The collected simulation measurements were processed using a MATLAB script and transferred to an Excel database for analysis, where each patient's three trials were averaged. Based on previous studies, a minimum accelerator-to-braking reaction time of 1 second (s) and a maximum force generated while braking exceeding 350 newtons (N) were used as thresholds. Patient outcome data was classified into four categories based on the results of both thresholds (Table 1).

RESULTS:

Within the first 25 days post-op, only 6% of the tested patients met both thresholds while half of the patients failed both thresholds (Category IV) or were classified as Category III (Figure 2, 3). Reaction time was primarily affected from 26-75 to 76-125 days post-op, while the maximum brake force range remained similar for both time frames. At 125+ days post-op, 61% of the patients fell in Category I, 21% fell in Category III, while Categories II and IV made up 13 and 4% respectively.

DISCUSSION AND CONCLUSION:

Reaction time and braking force are the dominant factors in driving and stopping safely. Regardless of weight-bearing tolerance, patients within 25 days post-op should not be permitted to drive due to a poor success rate (6%) in achieving both thresholds during this period. Given the variation in individual performance after 25 days post-op, physicians should consider full weight bearing, physical and mobility restrictions, drug intake, and ideally, a braking simulation test when determining patient driving readiness from 26+ days post-op. This preliminary analysis may also suggest exploring other covariates such as the patient's age and pain levels to determine a correlation between postoperative days and patients in the higher, less-functional categories (III and IV).

Figure 1: Custom driving simulator equipped with an accelerator and brake pedal uses a randomized green light and red light system to record a calibrated measurement of patient reaction time and break force.

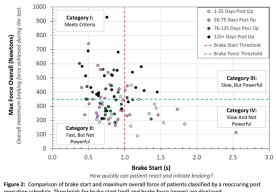

Figure 2: Comparison of brake start and maximum overall force of patients classified by a reoccuring post operation schedule. Thresholds for brake start (red) and brake force (green) are displayed.

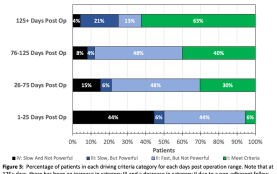

Figure 3: Percentage of patients in each driving criteria category for each days post operation range. Note that at 125+ days, there has been an increase in category III and a decrease in category II due to a non-adherent follow up schedule for all patients, which led to a minor shift in the study population.

Table 1: Categories for patient data are displayed on the left with paired descriptions of each category displayed on the right.

Category	Description
Category I: Meets Criteria	Average brake reaction time was less than 1 s and maximum overall force exceeded 350 N indicating the patient was ready to drive.
Category II: Fast, But Not Powerful	The patient failed to exceed 350 N of maximum overall force but met the brake start 1 s threshold.
Category III: Slow, But Powerful	The patient's brake reaction time failed to meet the 1 s threshold, but they exceed a maximum overall force of 350N.
Category IV: Slow And Not Powerful	The patient failed to meet brake reaction time and maximum overall force threshold criteria.