The Effect of Immobilization Devices and the Left Foot Driving Adaptor on Brake Response Time

Presenting: Jeremy K. Rush, MD (San Antonio, Texas)
Justin D. Orr, MD; Thomas C. Dowd, MD; Joseph R. Hsu, MD; Kevin L. Kirk, DO; James R. Ficke, MD

Summary: The ability to perform an emergency stop is essential for safe driving. Immobilization of the lower extremities is routinely performed for a variety of orthopaedic conditions. A prospective, observational study was conducted to assess the effect of immobilization devices on braking times. A driving simulator was used to assess total brake response time, reaction time, and braking time in thirty-five volunteers. Volunteers were assessed while wearing 1) normal footwear (control), 2) a controlled ankle motion (CAM) boot, 3) a removable short-leg cast (SLC) and, 4) while employing a left foot braking adapter (LFA). The mean total brake response time was increased compared to control in all groups (SLC, CAM, LFA). The mean reaction time was increased for the SLC and CAM groups. The mean braking time was increased in the CAM and LFA groups. Total brake response time while immobilized or while utilizing a left-foot adapter is significantly increased, or worsened, compared to when wearing normal footwear. The timing of return to driving is a critical decision to be made by the patient in consultation with the orthopaedic surgeon. This information may prove valuable to physicians when counseling patients on safe return to driving.

Objective: The ability to perform an emergency stop is essential for safe driving and can be represented by total brake response time, reaction time, and braking time. Immobilization of the lower extremities is routinely performed for a variety of orthopaedic conditions. The purpose of our study was to investigate the effect of immobilization devices on braking times utilizing a controlled ankle motion (CAM) boot, a short leg cast, and a left foot driving adaptor. Our hypothesis was that there is a significant difference in braking times in individuals wearing immobilization devices or utilizing a left foot driving adaptor compared to those wearing normal footwear.

Methods: We conducted a prospective, observational study to assess the effect of immobilization devices on braking times. Thirty-five healthy volunteers performed the trials. Eligibility criteria included adult volunteers who possessed a valid driver’s license, primarily drove vehicles with automatic transmissions, demonstrated protective sensation in their feet, and were not taking medications that might impair their ability to safely operate a motor vehicle. A driving simulator was utilized to assess total brake response time, reaction time, and braking time. Volunteers were assessed while wearing 1) normal footwear (control), 2) a controlled ankle motion (CAM) boot, 3) a removable short-leg cast (SLC) and finally 4) while utilizing a left foot braking adaptor (LFA).

Results: The mean total brake response time: (1) control: 571 msec, (2) CAM: 675 msec, (3) SLC: 640 msec, and (4) LFA: 639 msec. The mean reaction time: (1) control: 338 msec, (2) CAM: 417 msec, (3) SLC: 404 msec, and (4) LFA: 354 msec. The mean braking time: (1) control: 233 msec, (2) CAM: 258 msec, (3) SLC: 236 msec, and (4) LFA: 285 msec. The mean total brake response time was increased compared to control in all groups (SLC, CAM, LFA). The mean reaction time was increased for the SLC and CAM groups. The mean braking time was increased in the CAM and LFA groups.

Conclusions: The timing of return to driving when wearing a lower extremity immobilization device is a critical decision to be made by the patient in conjunction with the orthopaedic surgeon and other healthcare providers. Total brake response time while wearing a CAM boot or short-leg cast or while utilizing a left-foot adaptor is significantly increased compared to when wearing normal footwear. Total brake response time is also significantly increased when wearing a CAM boot compared to when wearing a short-leg cast. The increase in the total brake response time would mean an increase in the distance traveled by an automobile prior to stopping. This information may prove valuable when counseling patients wearing immobilization devices on safe return to driving.