Efficacy of Spinal Immobilization and Spinal Motion Restriction in Minimizing Cervical Spine Motion during Patient Transfer

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Context: Traditional spinal immobilization (SI) standards have changed in some emergency medical services (EMS) systems to exclude routine spineboard use. Rather, patients are managed by employing spinal motion restriction (SMR); whereby only a cervical collar is applied and a scoop stretcher or sheet are used during ground-to-stretcher and stretcher-to-bed transfers. Data comparing spine motion between SI and SMR are lacking. **Objective**: To compare the effectiveness of SI and SMR in limiting spine motion during two transfer scenarios. **Design:** Counterbalanced crossover. **Setting**: Controlled laboratory. **Patients or Other Participants:** Twenty males without previous history of destabilizing cervical spine injury (age=20.9±2.2yrs, mass=83.4±12.6kg, height=178.6±7.6cm). **Interventions**: Each participant was fitted with a rigid cervical collar and had inertial measurement unit sensors (MyoMotion IMS system, Noraxon USA, Inc, Scottsdale, Arizona) placed on the center of the forehead and on the sternum 2.54cm inferior to the base of the cervical collar. Participants were transferred using two distinct transfers: from the ground to an EMS stretcher (ground-to-stretcher) then from the stretcher to a simulated hospital bed (stretcher-to-bed). In SI trials, an athletic trainer 1) provided manual stabilization while the participant was secured to a rigid spineboard, 2) coordinated a six-plus-person lift onto the EMS stretcher, and 3) transferred participants onto the hospital bed and coordinated a log-roll, off the spineboard. In SMR trials, an athletic trainer 1) provided manual stabilization while 4 other rescuers used a scoop stretcher to transfer participants from the ground to the stretcher using a four-corner lift, 2) removed the scoop stretcher leaving the participant resting directly on the stretcher, and 3) coordinated a sheet transfer technique to transfer the participant to the simulated hospital bed. A two-factor repeated measures analysis of variance compared CIM and ROM in each plane (P≤.05). **Main Outcome Measures**: Sagittal, frontal, and transverse plane spine motion was measured in SI and SMR conditions for each transfer (ground-to-stretcher, stretcher-to-bed). Dependent variables included cumulative integrated motion (CIM) and peak range of motion (ROM). **Results**: For CIM, a significant condition effect was observed in all planes (sagittal: $F_{1,19}$=28.91, P<0.001; frontal: $F_{1,19}$=34.52, P<0.001; transverse: $F_{1,19}$=61.45, P<0.001). Regardless of transfer technique, SI resulted in greater sagittal (2508.7±1801.2°/s), frontal (1075.5±610.1°/s) and transverse (1128.9±650.6°/s) CIM compared to SMR (sagittal: 1530.2±956.9°/s; frontal: 554.5±236.9°/s; transverse: 482.0±253.8°/s). Additionally, transverse ROM was greater ($F_{1,19}$=25.15; P<0.001) during SI (11.2±3.7°) compared to SMR (7.3±3.5°). Lastly, frontal ROM was greater ($F_{1,19}$=5.96; P=0.025) with SI (10.3±2.6°) compared to SMR (7.4±1.9°) during the stretcher-to-bed transfer. **Conclusions**: In our study, SMR resulted in less spine motion when transferring patients on and off an EMS stretcher compared with SI. Although the spine motion required for injury exacerbation is unknown, the concept that less spine motion is better supports using SMR. **Word Count**: 443