VALIDATE AND ANALYZE MANNEQUIN’S SPINE MOVEMENTS TO IMPROVE TRAINING IN PRE-HOSPITAL CONTEXTS

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ABSTRACT

After an accident, when spinal injury is suspected, special care must be taken to minimize the risk for further injuries during the patient’s transfer to the hospital. The quality of spinal motion restriction (SMR) manoeuvres performed by responders is therefore crucial. In a training context, the evaluation of these techniques is currently subjectively performed by specialists or simulated patients, resulting in significant variation and learning difficulties. In order to improve training, a team of researchers from the Université de Sherbrooke has created a mannequin that replicates the mass, centre of gravity, and amplitude of movement of each segment of an unconscious person. This mannequin also features an instrumented spine allowing movement to be assessed. The study’s first objective is to model the system to assess the spine’s anatomical movements and validate these measurements. The second objective is to develop feedback metrics based on these measurements to pinpoint the cause of the faulty manoeuvres during a simulation scenario. To achieve these objectives, the spine was modelled using forward kinematics such that the resulting assessment of movement has clinical relevance. To evaluate the accuracy of this measurement, it was compared to that recorded by an optical system regarded as the accepted standard. Forty independent trials where the head and the pelvis were movement in each plane of motion and then in a combined manoeuvre where performed, at two different speeds. Accuracy, assessed by mean squared error, ranges between 0.7° and 1.5° amongst the different anatomical planes and is thus considered acceptable. The speed at which manoeuvres are performed do not have a significant impact on accuracy. To develop feedback metrics from involuntary movements, a total of 154 manoeuvres were performed by 14 individuals with different training level. Trials were then identified as either good or faulty depending on the importance of the relative movement assessed. Faulty trials were further labeled according to the type of error performed. Classification models were developed based on supervised learning. Overall, the decision tree model was selected for its global performance (70% to 83% accuracy) and ease of interpretation. The findings support the mannequin’s potential for measuring spinal movement in simulation scenarios. In addition, the error characterization model demonstrates an interesting potential for unbiased and clear feedback to enhance SMR manoeuvre training.