

Shoulder Range of Motion Measurements using Computer Vision Compared to Hand-Held Goniometric Measurements

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Abstract : Introduction: Range of motion (ROM) is often measured by physiotherapists using hand-held goniometer as part of mobility assessment for diagnosis. Due to the nature of hand-held goniometer measurement procedure, readings often tend to have some variations depending on the physical therapist taking the measurements (Riddle et al.). This study aims to validate computer vision software readings against goniometric measurements for quick and consistent ROM measurements to be taken by clinicians. The use of this computer vision software hopes to improve the future of musculoskeletal space with more efficient diagnosis from recording of patient's ROM with minimal human error across different physical therapists. Methods: Using the hand-held long arm goniometer measurements as the "gold-standard", healthy study participants (n = 20) were made to perform 4 exercises: Front elevation, Abduction, Internal Rotation, and External Rotation, using both arms. Assessment of active ROM using computer vision software at different angles set by goniometer for each exercise was done. Interclass Correlation Coefficient (ICC) using 2-way random effects model, Box-Whisker plots, and Root Mean Square error (RMSE) were used to find the degree of correlation and absolute error measured between set and recorded angles across the repeated trials by the same rater. Results: ICC (2,1) values for all 4 exercises are above 0.9, indicating excellent reliability. Lowest overall RMSE was for external rotation (5.67°) and highest for front elevation (8.00°). Box-whisker plots showed have showed that there is a potential zero error in the measurements done by the computer vision software for abduction, where absolute error for measurements taken at 0 degree are shifted away from the ideal 0 line, with its lowest recorded error being 8°. Conclusion: Our results indicate that the use of computer vision software is valid and reliable to use in clinical settings by physiotherapists for measuring shoulder ROM. Overall, computer vision helps improve accessibility to quality care provided for individual patients, with the ability to assess ROM for their condition at home throughout a full cycle of musculoskeletal care (American Academy of Orthopaedic Surgeons) without the need for a trained therapist.

Keywords : physiotherapy, frozen shoulder, joint range of motion, computer vision

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