Passive Range of Movement of the Shoulder: A Standardized Method for Measurement and Assessment of Intrarater Reliability

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Abstract

Objective: The purpose of this study was to determine the intrarater reliability and reproducibility of a standardized procedure for measuring passive shoulder movement in asymptomatic individuals.

Methods: A single assessor used a digital inclinometer and standardized protocol to measure the passive range of motion of 7 shoulder movements in 168 asymptomatic shoulders. Following a warm-up maneuver, 3 measurements were taken for each movement on 2 occasions. Both shoulders were measured using a standardized order of movement. Selection of measurement beginning with left or right shoulder was randomly determined. The entire process was repeated 7 days later to assess reproducibility. Intraclass correlation coefficients (ICCs) with 95% confidence intervals and standard errors of measurement (SEMs) were calculated to assess the intrarater reliability of the methods.

Results: The intrarater reliability of our methods was substantial for total shoulder flexion (ICC = 0.82, SEM = 12.3°), whereas all other movements demonstrated moderate reliability (ICC range = 0.64-0.75) except external rotation in neutral abduction, for which reliability was classed as slight (ICC = 0.28, SEM = 31°). Moderate reliability was evident for all movements on follow-up at 7 days (ICC range = 0.60-0.77).

Conclusions: These methods of measurement have moderate to substantial reliability for the majority of tested passive shoulder movements, with moderate reliability sustained after 1 week, in a large sample of asymptomatic individuals. (J Manipulative Physiol Ther 2015;38:218-224)

Key Indexing Terms: *Shoulder; Range of Motion; Articular; Reproducibility of Results*

Clinically reliable measurement tools are integral to understanding and accurately measuring shoulder function in both clinical and research populations.[1,2] Clinicians and researchers commonly perform a variety of measurements at the shoulder region that guide the clinical decision-making process.[2–7] One such measurement is range of motion (ROM), a fundamental component of the musculoskeletal examination.[4,8–10] Using reliable methods of measurement, researchers and clinicians can accurately distinguish real changes from normal variations in measurement,[5,11] thereby improving the precision of assessment and reassessment measures.

Various tools have been proposed to measure shoulder ROM, with evidence suggesting the use of instruments to be more reliable than visual estimation.[1] Investigations have been conducted into the reliability of a variety of instruments to measure shoulder ROM, including goniometry,[3,6,7,11–14] still photography,[6] and tape measurement.[6,9] Inclinometry has also been suggested as an alternative form of measurement of shoulder range in several clinical studies.[2,4,5,8–10,15–24] Both mechanical and electronic inclinometers are relatively inexpensive, portable, and easy to use, providing a practical alternative to other forms of measurement of the shoulder.[25]

Several studies have assessed both inter- and intrarater reliability of measurements using inclinometry of active shoulder ROM.[5,8,9,15–17,20] These have produced varied findings with intraclass correlation coefficients (ICCs) achieved ranging from 0.38 to 0.99 for various shoulder

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movements. Discrepancies in reliability estimates may be attributable to variations in movements assessed, lack of standardization of movement procedures, and the clinical status of the participant groups.

Evidence for the reliability of measurements using inclinometry of passive shoulder movement has been characterized by examination of limited movement directions and methodological inconsistencies.[2,4,10,16–19] However, to date, no studies have used a standardized methodology and a previously determined sample size to determine the intrarater reliability of a digital inclinometer to measure a comprehensive set of passive shoulder ROM tests. The aim of this study was to determine the intrarater reliability of a standardized method of measuring passive shoulder movements using a digital inclinometer in an asymptomatic population.

Methods

Subjects

Ninety asymptomatic adult participants, 54 women and 36 men, were recruited over a 2-month period from both staff and students of The University of Newcastle, Australia. Participants were eligible for inclusion if they were aged more than 18 years with pain-free shoulder movement and no history of shoulder pain in the preceding 12 months. Potential participants were excluded if they had current shoulder pain, a history of shoulder pathology within the preceding 12 months, or an inability to comprehend verbal instructions in the English language. Ethical approval for the study was granted by The University of Newcastle Human Research Ethics Committee (Approval H-2011-0106).

Study Design

This study used a repeated-measurement study design. A single assessor, a final-year Physical Therapy honors student, who had received previous training in the use of the inclinometer and the standardized procedures performed all measurements. The training consisted of 3 days of specific instruction and practice under the supervision of 2 highly experienced (30 years each) musculoskeletal clinicians and researchers. Each shoulder movement was performed 3 times during measurement, the entire procedure occurring on 2 occasions at initial evaluation and on 1 occasion at follow-up 7 days later. The assessor was blinded to the results of the initial measurements during each follow-up assessment.

Shoulder ROM Measurement

A standardized protocol for the measurement of passive shoulder movement using a digital inclinometer was performed based upon the method reported by Green et al[15] for assessing active shoulder movement. For movements performed in the sagittal and coronal planes, the participant was positioned seated firmly against the back of the chair to ensure trunk stabilization, with the head maintained in a neutral position. Total shoulder flexion and abduction were performed allowing movements of the entire shoulder complex. For each of the glenohumeral movements performed in sitting, an assistant provided manual downward pressure on the spine of the scapula to eliminate any contribution of scapula movement. Movements were assessed in the following order for all participants.

Total Shoulder Flexion. The participant's elbow was fully extended, with the thumb facing forwards to ensure neutral rotation. The inclinometer was placed on the anterior aspect of the arm, aligned parallel to the humerus. The participant was instructed not to arch back to avoid trunk extension. Leading with the thumb, the participant's arm was taken through full passive range (Fig 1a).

Total Shoulder Abduction. The participant's elbow was fully extended, with the thumb facing laterally to ensure neutral rotation. The inclinometer was placed on the lateral aspect of the arm, aligned parallel to the humerus. The participant was instructed not to laterally flex their trunk. Leading with the thumb, the participant's arm was taken through full passive range (Fig 1b).

Glenohumeral Flexion. The participant's scapula was stabilized by the assistant as previously described. The starting position, placement of the inclinometer, and movement direction were identical to the process described to measure total shoulder flexion (Fig 1c).

Glenohumeral Abduction. The scapula was stabilized in the same manner as for glenohumeral flexion. The participant's elbow was flexed to 90° for comfort to minimize placing tension on the axillary neural structures with scapula stabilization. Placement of the inclinometer was identical to total shoulder abduction. While ensuring 90° of elbow flexion, the participant's arm was then taken through full glenohumeral abduction range (Fig 1d).

The remaining movements were performed with the participant supine on a standard plinth. A towel was placed underneath the arm of the participant, with the thickness of toweling adjusted to ensure that the humerus was level with the plinth. This was determined by achieving a zero reading on the inclinometer when placed over the anterior aspect of the upper arm. The participant's elbow was maintained at 90° of flexion throughout each movement.

External Rotation in Neutral Abduction. The participant's elbow was flexed to 90°, with the forearm positioned in neutral rotation. The arm was positioned in neutral abduction such that the humerus rested parallel to the body. The inclinometer was placed along the anterior aspect of the participant's forearm. While maintaining 90° of elbow flexion, neutral rotation, and neutral abduction, the participant's arm was taken through full external rotation range (Fig 2a).