ORIGINAL ARTICLE

Intraobserver Reliability of 4 Physiologic Movements of the Shoulder in Subjects With and Without Symptoms

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ABSTRACT. Valentine RE, Lewis JS. Intraobserver reliability of 4 physiologic movements of the shoulder in subjects with and without symptoms. Arch Phys Med Rehabil 2006;87: 1242-9.

Objective: To assess intraobserver reliability of 4 physiologic movements of the shoulder.

Design: Test-retest analyses. Blinded data entry.

Setting: Outpatient department in National Health Service teaching hospital.

Participants: Forty-five asymptomatic volunteers and 45 subjects with shoulder symptoms.

Interventions: Not applicable.

Main Outcome Measures: Intraclass correlation coefficients (ICC), 95% confidence intervals, and standard error (SE) of measurements for bilateral measurements of shoulder flexion and abduction (gravity dependent inclinometer), shoulder external rotation (tape measure), and shoulder internal rotation (visual estimation).

Results: For subjects without symptoms, single measure ICC results ranged from .85 to .96; SE of measurement results for the angular movements ranged from 2.1° to 2.8° and for the linear measurements 1.1 to 1.6cm. For subjects with symptoms, single measure ICC results ranged from .82 to .98; SE of measurement results for the angular movements ranged from 1.5° to 13.3° and for the linear measurements 1.3 to 1.6cm.

Conclusions: With the exception of painful shoulder flexion in the group of subjects with symptoms, the single-measure ICC results were very good to excellent and the highest SE of measurement values were 5.3° for the angular measurements and 1.6cm for the linear measurements. For clinicians involved in the management of subjects with shoulder symptoms, the SE of measurement results provide guidance as to the error associated with the individual measurements. Using the SE of measurement results, a clinician may determine if a clinically important change, be it negative or positive, has occurred as a result of any intervention offered.

Key Words: Intraobserver variation; Outcome assessment (health care); Range of motion, articular; Rehabilitation; Shoulder.

MUSCULOSKELETAL DISORDERS of the shoulder are extremely common, with 1 in 3 people experiencing shoulder pain at some stage of their lives.[1,2] The clinical investigation of patients presenting with shoulder pathology involves: history taking, using appropriate outcome measurement scores, and assessing the shoulder with a series of clinical tests that include measuring the physiologic shoulder range of motion (ROM). Measuring ROM is a necessary and important part of the clinical examination, because deficiencies of physiologic movement have been reported in groups of patients whose shoulder pathology is associated with a traumatic onset, such as in sport, as well as those with no identifiable traumatic onset of symptoms.

Measuring shoulder ROM prior to, during, and at the end of a course of treatment provides the clinician with an indication of the effectiveness of the intervention. Randomized clinical trials investigating the effect of intervention on shoulder pathology have included measurements of shoulder ROM among the outcome measurements assessed to determine the effectiveness of the interventions.[3-5] As such it is essential that reliable methods of measuring shoulder ROM that are easily accessible to clinicians are available to measure this component of shoulder function. The physiologic movements of the shoulder that are most commonly measured include flexion, abduction in the plane of the scapular, external rotation, internal rotation, and hand behind back.[3-6]

Recommendations for measuring internal and external rotation of the shoulder involve placing the shoulder at 90° abduction while the patient is lying in the supine position.[7,8] Shoulder elevation in this range frequently provokes pain[3,5] and is therefore not appropriate for patients experiencing discomfort in this range. It would therefore be advantageous to have a reliable method of measuring both internal and external rotation with the arm by the side, which is generally a less provocative position. The assessment of hand behind back is recommended by the American Academy of Orthopaedic Surgeons and the Society of American Shoulder and Elbow Surgeons,[9] because it is commonly described by patients as a maneuver associated with restriction of movement and pain, when dressing, attending to personal hygiene, and during other activities of daily living (ADLs). However, the movement of hand behind back should not be considered as an assessment of the ability of the shoulder to internally rotate. Mallon et al[10] reported that measuring shoulder internal rotation by the maximal vertebral level reached by the patient's thumb is an inexact method to measure this range. They conducted a radiologic analysis of the hand behind back movement in 8 subjects without shoulder symptoms and reported that internal rotation occurred at the glenohumeral joint when the arm was in front of the body and that scapulothoracic articulation contributed to the hand behind back maneuver by both extension (anterior tilt) and downward (internal) rotation of the scapula. They also reported from radiologic analysis that flexion at the elbow contributed substantially to the movement. In addition to this, Edwards et al[11] argued that the range of hand behind back would be adversely influenced by conditions involving the elbow, wrist, or thumb. As such, it is not possible to determine the amount of gleno-

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Table 1: Review of Studies Investigating the Reliability of Measuring Shoulder ROM

Study	Measurement	Subjects	Method	Position	Intrarater Reliability	Interrater Reliability	Clinical Comment
Riddle et al[13]	Flexion, passive*	S	Short goniometer	Variable	$ICC_{1,1}$=.98	$ICC_{1,1}$=.87	SEM and 95% CI NR
Riddle et al[13]	Flexion, passive*	S	Long goniometer	Variable	$ICC_{1,1}$=.98	$ICC_{1,1}$=.89	SEM and 95% CI NR
Green et al[17]	Flexion, active to P1	S	Inclinometer	Sitting	ICC=.49	ICC=.72	SEM and 95% CI NR
Sabari et al[34]	Flexion, passive	AS+?S	Goniometer	Supine	ICC_2=.94		SEM and 95% CI NR
Sabari et al[34]	Flexion, active	AS+?S	Goniometer	Supine	ICC_2=.95		SEM and 95% CI NR
Sabari et al[34]	Flexion, passive	AS+?S	Goniometer	Sitting	ICC_2=.95		SEM and 95% CI NR
Sabari et al[34]	Flexion, active	AS+?S	Goniometer	Sitting	ICC_2=.97		SEM and 95% CI NR
Hayes et al[18]	Flexion, passive to end ROM	S	Visual	Sitting	$ICC_{2,1}$=.59, SEM=13°, 95% CI, ±26°	$ICC_{2,1}$=.70, SEM=19°, 95% CI, ±38°	Not reliable
Hayes et al[18]	Flexion, active to end ROM	S	Goniometer	Sitting	$ICC_{2,1}$=.53, SEM=17°, 95% CI, ±34°	$ICC_{2,1}$=.69, SEM=25°, 95% CI, ±50°	Not reliable
Riddle et al[13]	Abduction, passive*	S	Short goniometer	Variable	$ICC_{1,1}$=.98	$ICC_{1,1}$=.84	SEM and 95% CI NR
Riddle et al[13]	Abduction, passive*	S	Long goniometer	Variable	$ICC_{1,1}$=.98	$ICC_{1,1}$=.87	SEM and 95% CI NR
Croft et al[21]	Abduction, passive to P1	S	Diagram	Not stated		ICC=.84	SEM and 95% CI NR
Croft et al[21]	Abduction, passive end ROM	S	Diagram	Not stated		ICC=.95	SEM and 95% CI NR
Croft et al[21]	Abduction, preselected range	Not stated	Visual ROP	Not stated		ICC=.99	SEM and 95% CI NR
Green et al[17]	Abduction, active to P1	S	Inclinometer	Sitting	ICC=.38	ICC=.77	SEM and 95% CI NR
Sabari et al[34]	Abduction, passive	AS+?S	Goniometer	Supine	ICC_2=.98		SEM and 95% CI NR
Sabari et al[34]	Abduction, active	AS+?S	Goniometer	Supine	ICC_2=.99		SEM and 95% CI NR
Sabari et al[34]	Abduction, passive	AS+?S	Goniometer	Sitting	ICC_2=.95		SEM and 95% CI NR
Sabari et al[34]	Abduction, active	AS+?S	Goniometer	Sitting	ICC_2=.97		SEM and 95% CI NR
Hayes et al[18]	Abduction, passive to end ROM	S	Visual	Sitting	$ICC_{2,1}$=.60, SEM=21°, 95% CI, ±42°	$ICC_{2,1}$=.66, SEM=19°, 95% CI, ±38°	Not reliable
Hayes et al[18]	Abduction, active to end ROM	S	Goniometer	Sitting	$ICC_{2,1}$=.58, SEM=23°, 95% CI, ±46°	$ICC_{2,1}$=.69, SEM=21°, 95% CI, ±38°	Not reliable
de Winter et al[35]	Abduction, passive†	S	Electronic inclinometer	Sitting		ICC=.83 (affected side), ICC=.28 (CL side)	Changes in ROM <20°–25° = possible ME
Riddle et al[13]	ER, passive*	S	Short goniometer	Variable	$ICC_{1,1}$=.98	$ICC_{1,1}$=.90	SEM and 95% CI NR
Riddle et al[13]	ER, passive*	S	Long goniometer	Variable	$ICC_{1,1}$=.99	$ICC_{1,1}$=.88	SEM and 95% CI NR
Croft et al[21]	ER, passive to end ROM	S	Diagram	Not stated		ICC=.43	Not reliable
Croft et al[21]	ER, preselected range	Not stated	Visual ROP	Not stated		ICC=.37	Not reliable
Green et al[17]	ER, in neutral-active to P1	S	Inclinometer	Supine	ICC=.85	ICC=.88	SEM and 95% CI NR
Green et al[17]	ER, in abduction-active to P1	S	Inclinometer	Supine	ICC=.75	ICC=.65	SEM and 95% CI NR
Hayes et al[18]	ER, passive to end ROM	S	Visual	Sitting	$ICC_{2,1}$=.67, SEM=11°, 95% CI, ±22°	$ICC_{2,1}$=.57, SEM=14°, 95% CI, ±28°	Not reliable
Hayes et al[18]	ER active to end ROM	S	Goniometer	Sitting	$ICC_{2,1}$=.65, SEM=14°, 95% CI, ±28°	$ICC_{2,1}$=.57, SEM=14°, 95% CI, ±28°	Not reliable
de Winter et al[35]	ER, passive‡	S	Electronic inclinometer	Supine		ICC=.90 (affected side), ICC=.56 (CL side)	Changes in ROM <20°–25° = possible ME
Riddle et al[13]	IR, passive*	S	Short goniometer	Variable	$ICC_{1,1}$=.93	$ICC_{1,1}$=.43	SEM and 95% CI NR
Riddle et al[13]	IR, passive*	S	Long goniometer	Variable	$ICC_{1,1}$=.94	$ICC_{1,1}$=.55	SEM and 95% CI NR
Green et al[17]	IR, in abduction-active to P1	S	Inclinometer	Supine	ICC=.82	ICC=.44	SEM and 95% CI NR
Green et al[17]	HBB to P1	S	Visual	Standing	ICC=.84	ICC=.73	SEM and 95% CI NR