APPENDIX 2: RELIABILITY

Testing procedure

We conveniently recruited 19 elite handball players aged 16 to 18 years from a local sport club. All participants attended two testing sessions, separated by 1 week. Participants rotated between three different test stations. Each station involved assessments of either: 1) shoulder internal and external rotational isometric strength 2) glenohumeral internal and external rotational ROM or 3) abduction isometric strength.

Scapular control assessment was based on the procedure described by Mcclure et al. [1] The interreliability was only evaluated at one testing session, and was evaluated in a group of 20 physiotherapist students prior to study start. We evaluated each shoulder independently and classified them as (a) normal scapular control, (b) subtle scapular dyskinesis or (c) obvious dyskinesis during shoulder flexion and abduction movements. The final evaluation of scapular control was based on a combined flexion and abduction movements as described by Mcclure et al. [1].

Additional details of the testing procedures are included as Appendix1.

Statistical analysis

All statistical analyses were conducted in Stata version 14.1 software (StataCorp, College Station, TX, USA). For test-retest reliability we calculated LOA [2, 3] and ICC based on the max value of three repeated strength measurements at each test session. ICCs were calculated using a two-way mixed absolute agreement model (ICC 3,1) [4]. Intertester reliability of scapula control for each arm was estimated with Cohen's kappa coefficients (κ). To assist the interpretation of κ outcomes, we also calculated prevalence-adjusted bias-adjusted kappa coefficients (PABAK) [5].

Results

Rotational strength and range of motion

TABLE 1 Test-retest reliability of abduction strength and internal and external rotational shoulder strength, and range of motion on 19 male handball players.

	N	Bias (95% CI)	LOA	ICC
Rotational strength dominant arm 0 degrees rotation				
Ext *(N)*	16*	1.4 (-2.4 to 5.1)	-12.7 to 15.4	0.99
Int *(N)*	16*	- 1.3 (-5.3 to 2.6)	-16.1 to 13.5	0.99
Rotational strength dominant arm 30 degrees rotation				
Ext *(N)*	16*	1.4 (-1.2 to 4.0)	-8.6 to 11.4	0.99
Int *(N)*	16*	0.6 (-2.7 to 4.0)	-12.1 to 13.4	0.99
Abduction strength dominant arm				
(N)	19	-0.5 (-4.4 to 3.4)	-15.0 to14.0	0.95
Abduction strength non-dominant arm				
(N)	16*	1.4 (-1.7 to 4.5)	-10.3 to13.1	0.98
Range of motion dominant arm				
Ext *(Degrees)*	17*	-0.7 (-1.4 to -0.1)	-3.2 to1.8	0.99
Int *(Degrees)*	17*	0.5 (-0.6 to 1.7)	-3.9 to 5.0	0.95
Range of motion non-dominant arm				
Ext *(Degrees)*	17*	-0.3 (-1.3 to 0.5)	-3.6 to 2.9	0.99
Int *(Degrees)*	17*	-0.8 (-1.7 to 0.1)	-4.0 to 2.5	0.96

* Some players not tested due to either pain during testing or lack of time at the test sessions.

Scapula control

The overall agreement was estimated to 0.83, kappa to 0.73 and PABAK to 0.66. The two observers individual assessments are shown in Table 2.

TABLE 2 The two observers' results of assessment of scapular control on 20 physiotherapy students (40 arms)

		Observer 1			
		Normal	Subtle	Obvious	**Total**
Observer 2	Normal	14	1	3	18
	Subtle	0	6	3	9
	Obvious	0	0	13	13
	Total	14	7	19	40

References

1 McClure P, Tate AR, Kareha S, *et al.* A clinical method for identifying scapular dyskinesis, part 1: reliability. *J Athl Train* 2009;44:160-4.

2 Bland JM, Altman DG. Comparing methods of measurement: why plotting difference against standard method is misleading. *Lancet* 1995;346:1085-7.

3 Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet* 1986;1:307-10.

4 Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. *Psychological bulletin* 1979;86:420-8.

5 Byrt T, Bishop J, Carlin JB. Bias, prevalence and kappa. *J Clin Epidemiol* 1993;46:423-9.