Comparison of range of motion tests with throwing performance and kinematics in elite team-handball players

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Introduction

- Throwing requires: Shoulder stability ↔ mobility (Borsa et al., 2008)
- Altered shoulder mobility caused by adaptive structural changes to the joint due to the extreme physiological demands of the overhead activity (Kibler, et al., 1996; Miyashita et al., 2008b).
- Possible injury enhancement (Kibler et al., 1996; Wang et al., 2004; Borsa et al., 2008; Joshi, et al., 2011).

Introduction

- In several overhead sports altered rotational range of motion (ROM) patterns that favour increased external rotation and limited internal rotation ROM (Chandler et al., 1990; Kibler et al., 1996; Wang, et al., 2004).
- Hypermobility (increased maximal external rotation angle) → allow larger arm cocking → a positive effect on ball velocity (Wang et al., 2004; Stodden et al., 2005; van den Tillaar & Ettema, 2006).
- In handball throwing internal rotation movement one of the main contributors in overarm throwing in team handball (Fradet et al., 2004; van den Tillaar & Ettema, 2007)

Introduction

- This mobility often tested by active and passive range of motion tests conducted by physical therapists.
- Maximal glenohumeral internal and external rotation angle measured = measurement of shoulder mobility (Ellenbecker, et al., 2002; Borsa, et al., 2006).
- ROM compared with normal population or non-dominant arm.
- most studies performed in baseball (Werner, et al., 2001; Ellenbecker et al., 2002; Borsa et al., 2006; Laundner, et al., 2013), tennis (Chandler et al., 1990; Kibler et al., 1996) and water polo (Witwer & Sauers, 2006).

Introduction

The question arises:

- Measured range of motion of the external rotation also influences the actual throwing kinematics.
- In baseball players a correlation between passive ROM of external rotation and the maximal external rotation angle during pitching. (Miyashita et al., 2008a; 2008b)
- They indicated that this relationship could be associated with the incidence of elbow injuries in baseball players (Miyashita et al., 2008a; 2008b)

Introduction

Purpose

To compare the active and passive ROM of the glenohumeral external rotation with the maximal external rotation and throwing performance during different throws with different wind-up techniques in elite team handball players.

- Help us to identify potential fast throwers or to recognise potential injuries combined with changed kinematics (Werner et al., 2001; Miyashita et al., 2008b).

Method

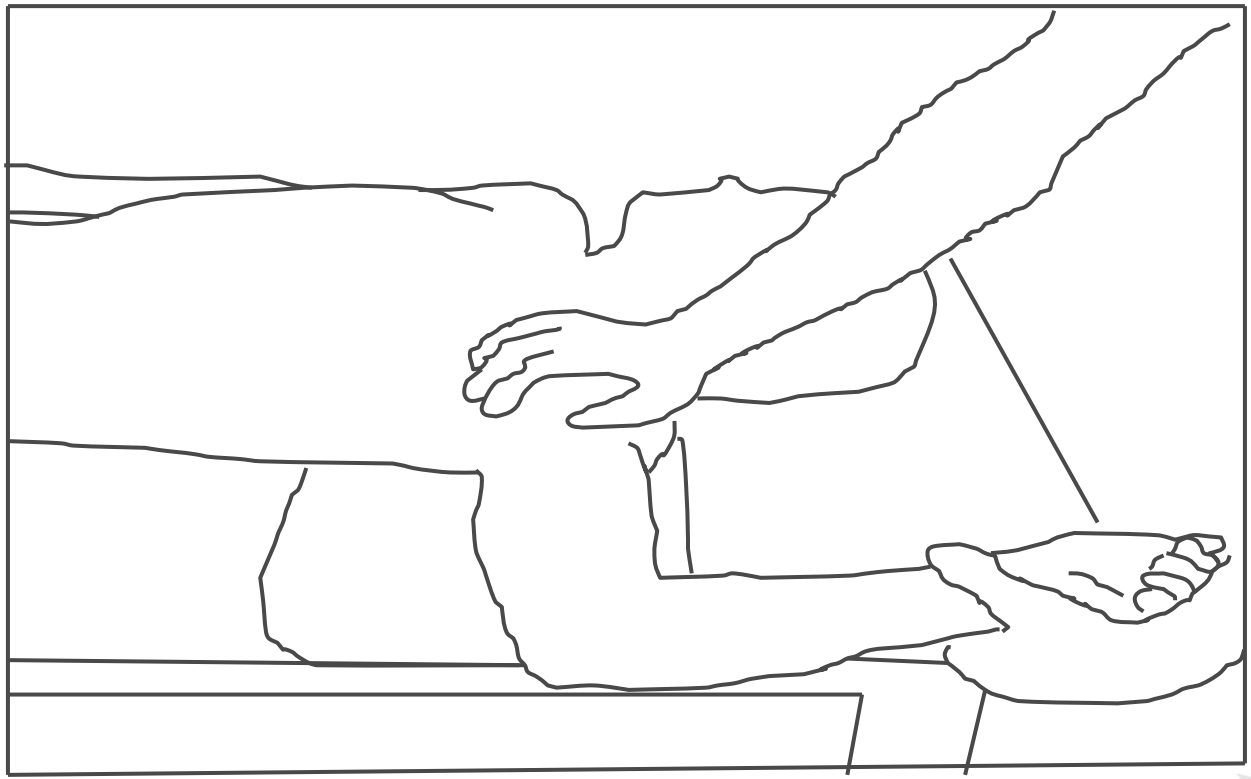
Set up:

22 elite handball players (11 ♀, age 19.6±3.0 yr, body mass 69.9±5.5 kg, height 1.75±0.05 m; 11 ♂, age 23.6±5.2 yr, body mass 87.0±6.8 kg, height 1.85±0.05 m) tested in throws with circular and whip-like wind up:

- Standing 7 m. throw
- Set shot with run-up (2 steps)
- Jump throw with run-up (2 steps)
- Passive and active ROM tests

Methods

Measurements:



- Active and Passive range of motion test (external rot. Angle)

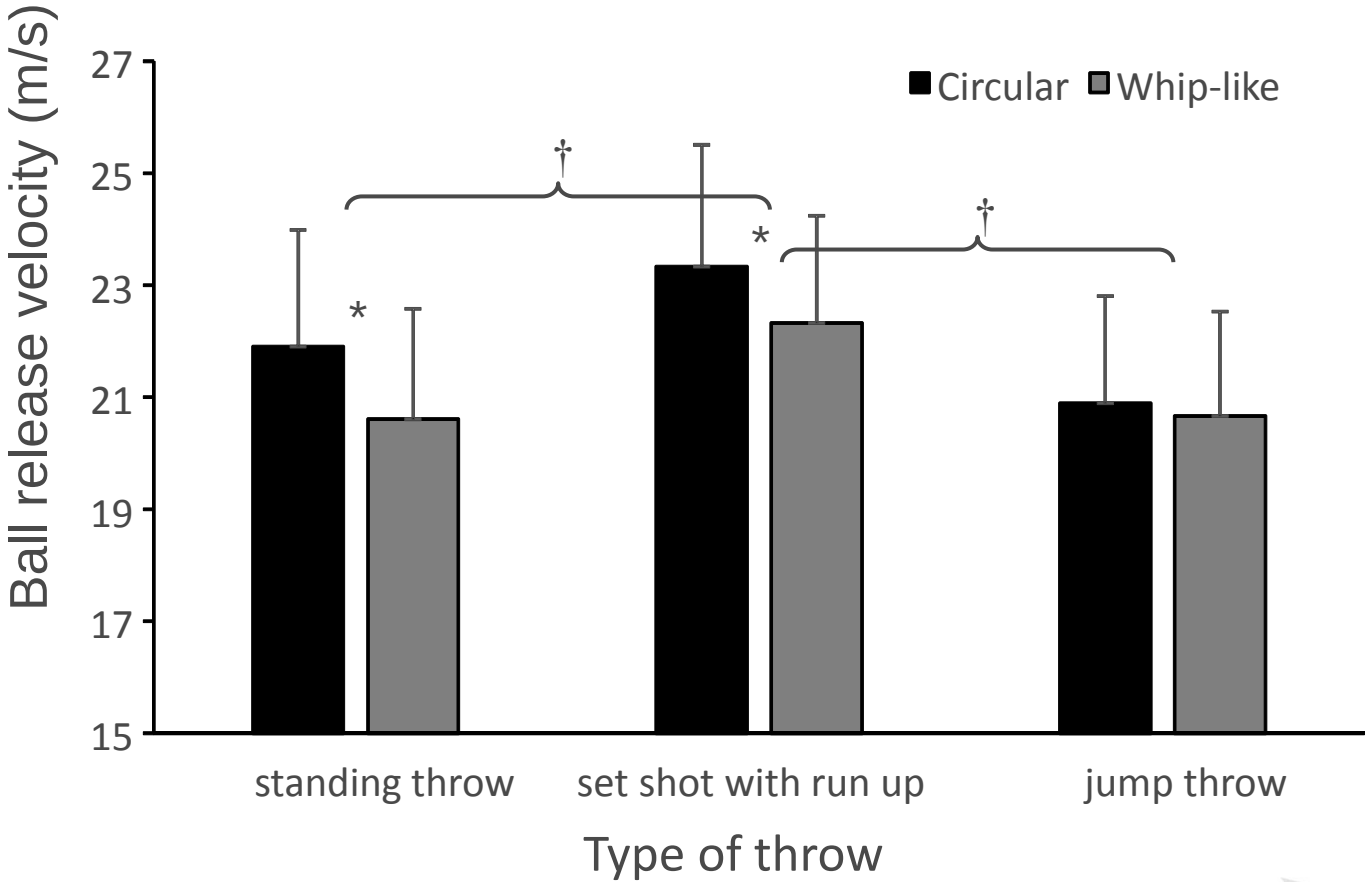
Methods

Measurements:

- Maximal external rot. angle during the different throws
- Maximal ball velocity
- 7 cameras 3D at 500 Hz with Qualysis Tracking Manager

Results

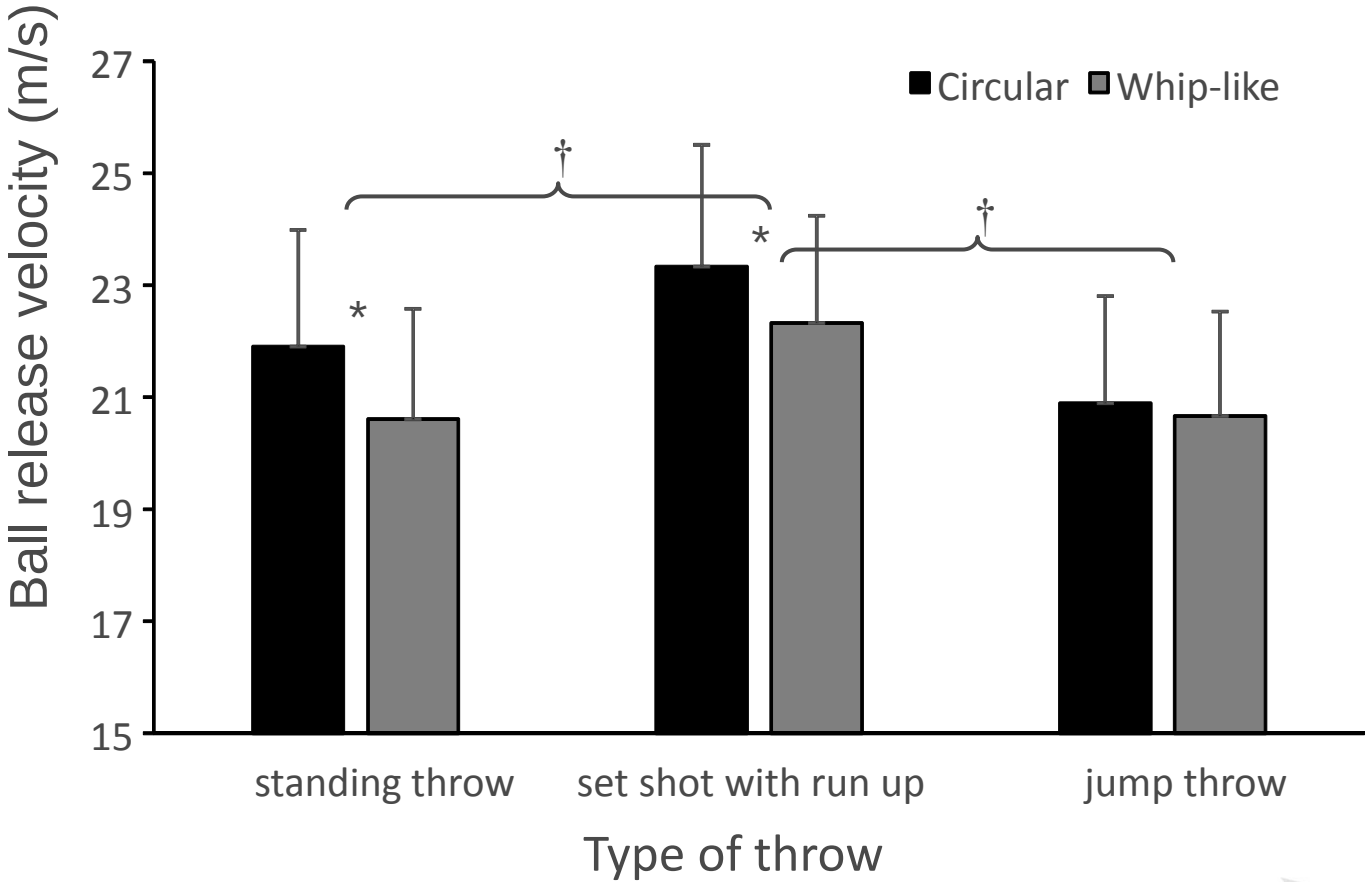
Velocity



- Significant lower ball velocity with whip-like wind up

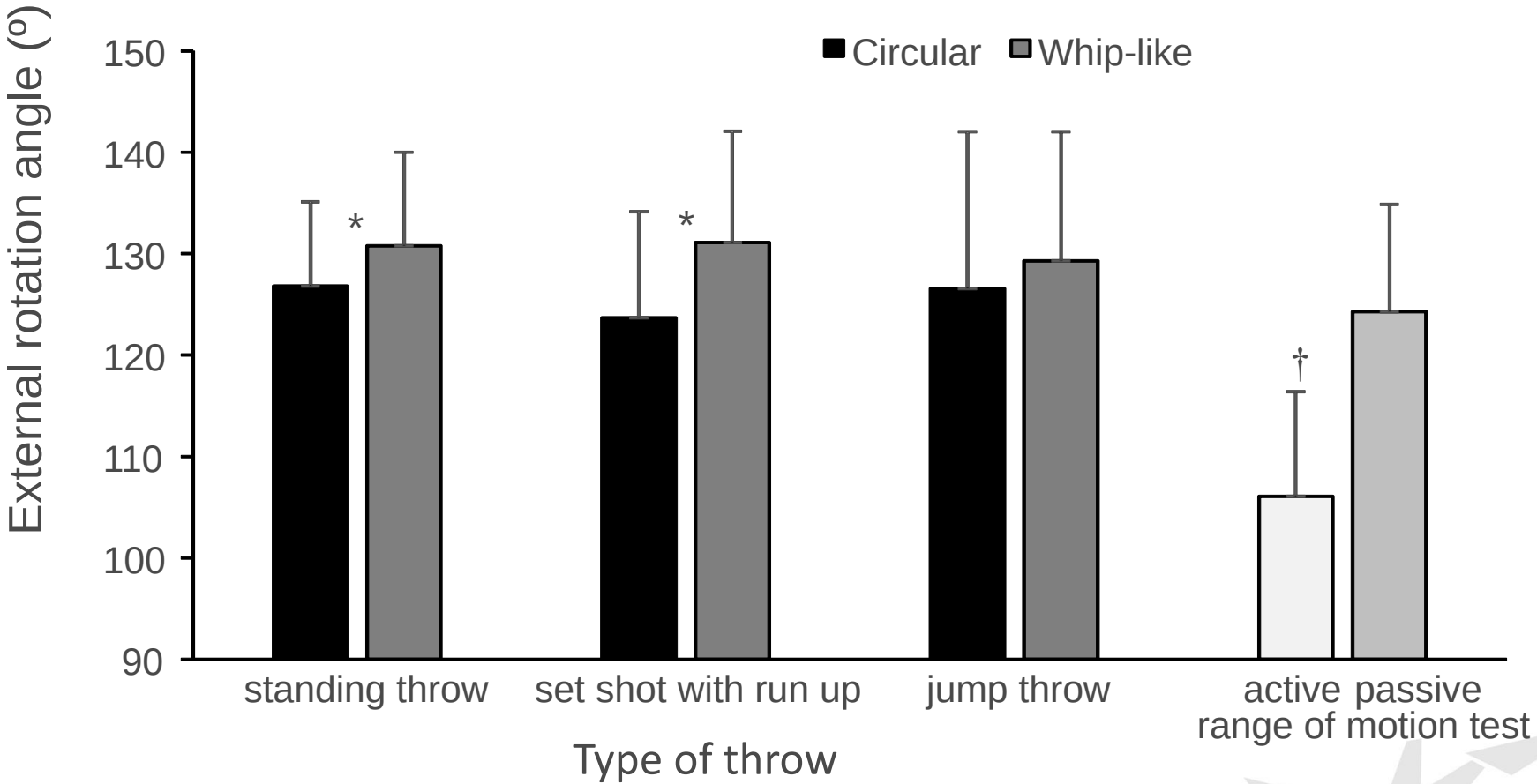
Results

Velocity



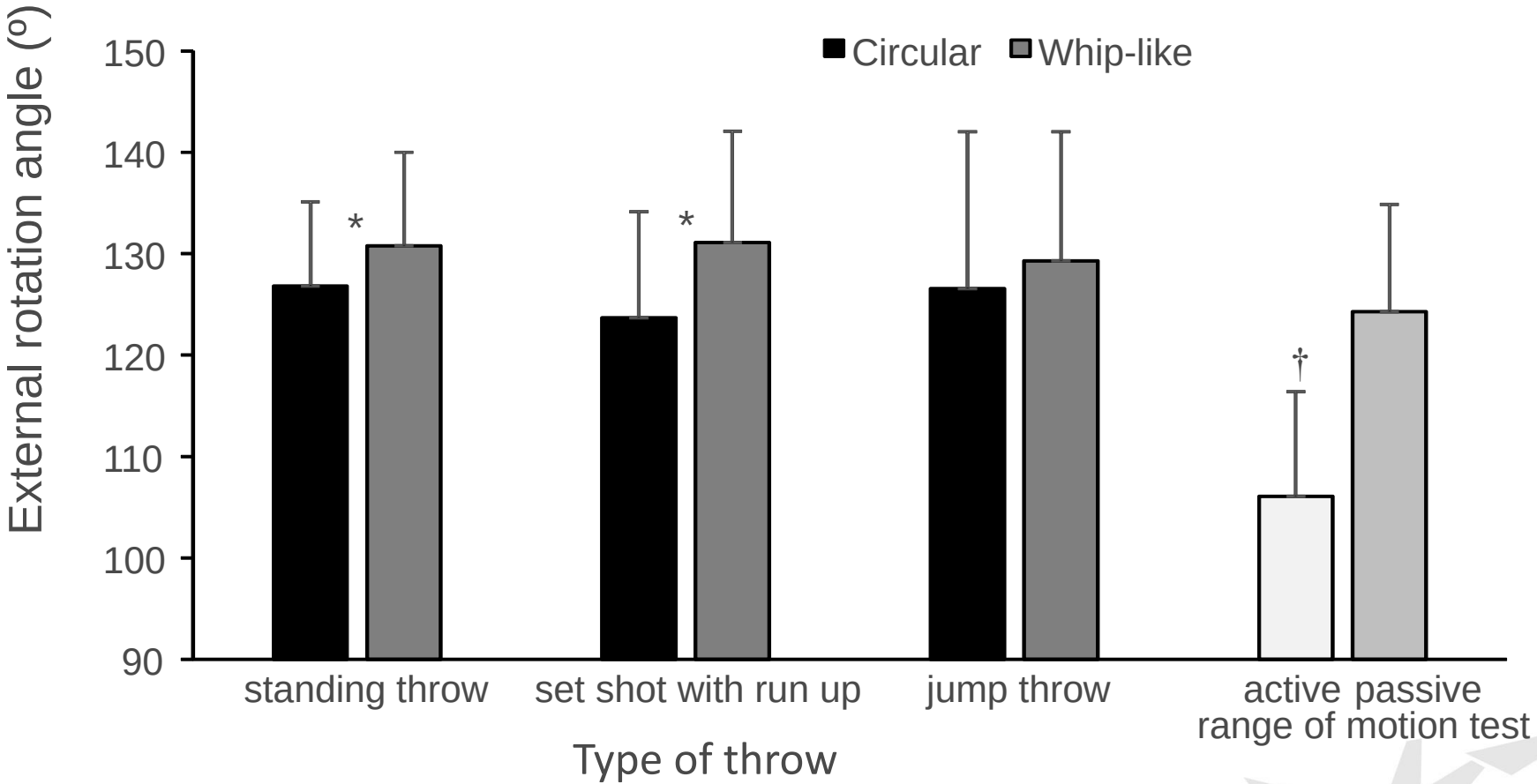
- Significant higher ball velocity with set shot

Results



- Significant higher ROM with whip-like wind-up

Results



- Significant lower ROM in active ROM test

Results

	Test	Maximal external rotation angle					
		Standing throw		Set shot with run-up		Jump throw	
	PROM	Whip-like	Circular	Whip-like	Circular	Whip-like	Circular
Active ROM	0.84*	0.15	0.40	0.40	0.18	0.29	0.24
Passive ROM	-	0.04	0.35	0.29	0.10	0.14	0.18
		Maximal ball velocity					
		Standing throw		Set shot with run-up		Jump throw	
		Whip-like	Circular	Whip-like	Circular	Whip-like	Circular
Active ROM		-0.40	-0.16	-0.38	-0.06	0.02	-0.20
Passive ROM		-0.39	-0.10	-0.29	-0.02	-0.15	-0.16

- No significant correlations ROM tests – performance and kinematics

Discussion

- The glenohumeral ROM of the external rotation angles comparable with experienced baseball players (Myers et al., 2006; Miyashita et al., 2008a; 2008b) and tennis players (Myers et al., 2009) indicating that elite handball players have the same external rotation ROM as in other overhead sports (Wagner, et al., 2012).
- Highest correlation (r = 0.40; p = 0.065) between the maximal external rotation in the circular wind-up throw and the active ROM of external rotation angle.
- Comparable with baseball pitchers (r = 0.46) Miyashita et al. (2008b)

Discussion

- Active ROM of the external rotation was lower than passive ROM measurements due to active muscle tonus
- Difference in ext rot. angle between whip-like and circular like wind up probably caused by a powerfully proprioceptic response which reduces the tonus activation of the rotator cuff muscles (O'Connel & Gardner, 1972)
- More stress on the capsule, ligaments and muscular structures of the glenohumeral joint, thereby increasing the risk of injuries in this joint (Miyashita et al., 2008a)

Discussion

- No significant correlations ROM tests – performance and kinematics
- Healthy subjects → difficult to state whether the external rotation angle changes in throwing when a shoulder injury occurs.
- Future studies should investigate whether the changes in the glenohumeral ROM also influence the kinematics, especially the external rotation angle during throws and when injured.

Conclusion

- Measuring active and passive ROM in healthy handball players does not give any extra information about their throwing performance.
- ROM tests not to be used to identify potential fast throwers or injuries

Thank you for your attention