Assessing the Validity of Handheld Dynamometry for Shoulder Rotational Strength Testing

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Background

- Shoulder injury is highly prevalent in individuals who participate in high demand upper extremity activities including repetitive overhead occupation or sport.
- Handheld dynamometry is used to assess rotator cuff strength to monitor progress in injury prevention programs, shoulder rehabilitation, and determine readiness for return to sport, yet shoulder injury and reinjury rates persist.
- Clinically, shoulder strength is measured using handheld dynamometry in multiple positions, with the clinician providing instruction to minimize compensations in torque direction and agonist muscles to produce the intended result.
- The extent of out of plane force production (quantified by 3D load cell) and compensatory muscle use (quantified by EMG) is lacking which may challenge the validity of internal/external rotation strength testing with a dynamometer.
- **We aim to evaluate compensations that occur with handheld dynamometry in the torque direction and the extent that the rotator cuff is active relative to shoulder agonists.**

Methods

Strength Measurement

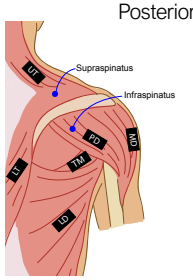
Handheld dynamometer

3-dimensional load cell

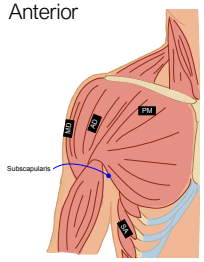
Internal, external rotation & abduction joint torque magnitude and direction was compared between handheld dynamometry and 3D load cell.

Electromyography (EMG)

Posterior



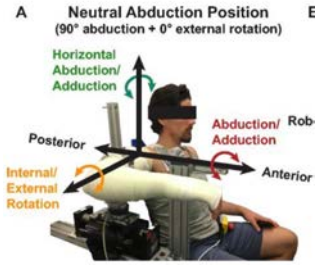
Anterior



EMG was simultaneously collected in rotator cuff and shoulder muscles. Black rectangles indicate surface EMG sensors.

Testing Position

90/0 position



Shoulder 90/0 positioning was assessed via HHD and 3D load cell to identify compensations

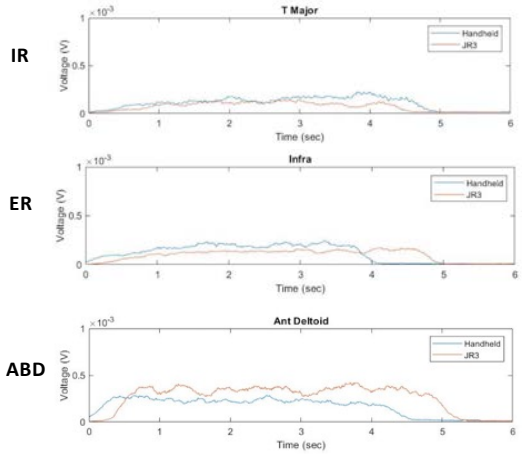
Results

Torque

	ABD	IR	ER	ER:IR ratio
HHD (n)	150.8	141.4	110.1	.779
HHD (nm)	**37.7**	**29.7**	**26.4**	**.889**
3D (nm)	**68.4**	**22.0**	**23.1**	**1.05**

★ **ER off axis in ABD was 30.1nm (30% greater than ER torque generated)**
IR off axis in ADD 37.3nm (70% greater than IR torque)

EMG



Clinical Implications

- Understanding how compensations in force direction and muscle recruitment affects the validity of handheld dynamometry torque measurement may be useful in providing recommendations for improved cuing and positioning during clinical strength assessment
- Inaccurate measurement of shoulder rotational strength may result in early clearance to return to high demand activity, resulting in possible re-injury

References: [1] Van Harlinger et al [2] Reimann et al [3] Makhni EC et al