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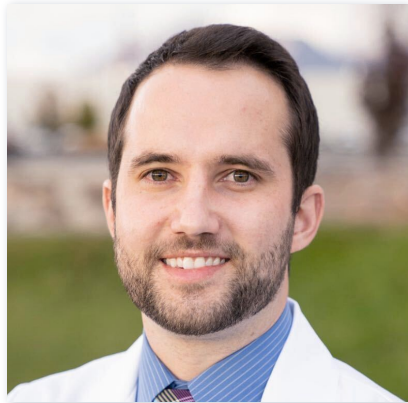
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Foundations of Strength Testing:
Techniques for Elbow Flexion,
Extension

Wednesday September 25th, 2024

Introductions:



Dr. Daniel G. Stewart,
PT, DPT



Becky Alwood,
MHS, OTR/L

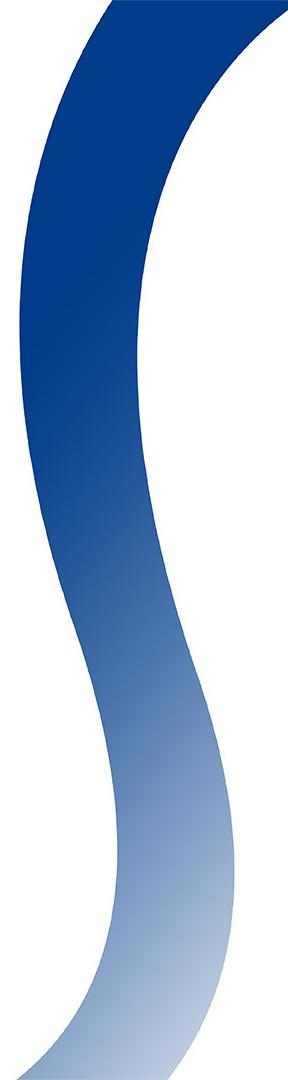


Dr. Frank Aerts,
PT, DScPT, OCS

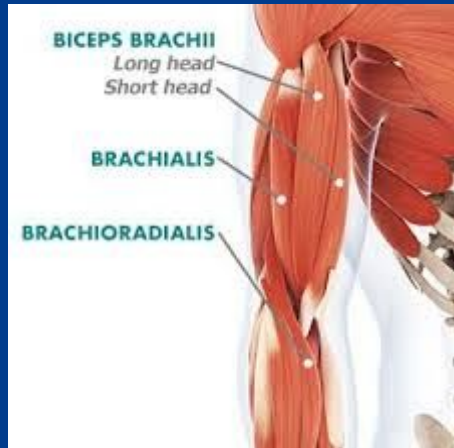
Agenda

- Introduction to Elbow Strength Testing: Elbow Flexion and Elbow Extension
- Overview of how to test the Elbow
 - Flexion
 - Extension
- Case Study- Analyzing the data
- Case Study- Possible rehab interventions
- Introduction to “HAND-HELD DYNAMOMETRY IN DAILY CLINICAL PRACTICE”

Elbow Flexion



Elbow Flexion



Muscle	Origin	Insertion	Innervation
Biceps Brachii	Long head - supraglenoid tubercle of the scapula. Short head - coracoid process of the scapula.	Long head - radial tuberosity. Short head - bicipital aponeurosis to the fascia on the medial side of the forearm.	Musculocutaneous nerve, C5, C6, C7.
Brachialis	Anterior lower half of humerus and medial and lateral intermuscular septa.	Coronoid process and tuberosity of ulna	Musculocutaneous nerve, C5, C6 and small supply from radial nerve, C7.
Brachioradialis	Upper two-thirds of the lateral supracondylar ridge of the humerus.	Styloid process of the radius	Radial nerve, C5, C6.

Elbow Flexion



Seated w/o Strap

[LINK](#)

Seated w Strap

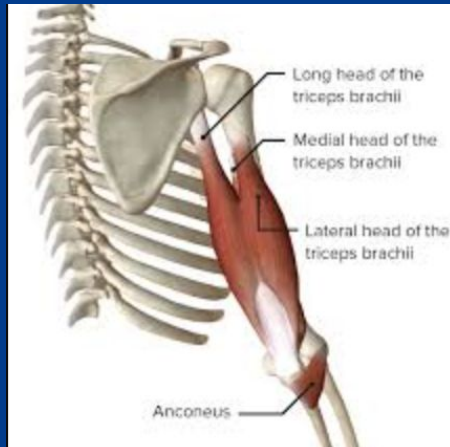
[LINK](#)

- Can test in Any position
- Testing at different angles: **Neutral, Mid range, End Range**, etc
- **Strap or No Strap**

Elbow Extension



Elbow Extension



Muscle	Origin	Insertion	Innervation
Triceps Brachii	Long head - infraglenoid tubercle of scapula. Lateral head - upper half of the posterior humerus. Medial head - lower half of the posterior humerus inferomedial to spiral groove and both intermuscular septa.	Humerus - posterior part of the upper surface of olecranon process of ulna and posterior capsule.	Radial nerve, C7, C8 from posterior cord.

Elbow Extension



Elbow Extension Supine w/o Strap

[LINK](#)

Elbow Extension Supine w/ Strap

[LINK](#)

- Can test in **All Positions**
- Testing at different angles: **Neutral, Mid Range, End Range**, etc
- **Strap or No Strap**



Department of
Physical Therapy
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Berrien Springs, Michigan, USA



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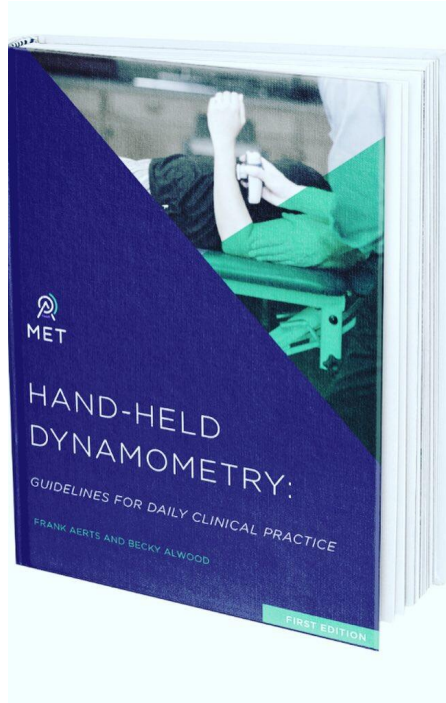
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HAND-HELD DYNAMOMETRY IN DAILY CLINICAL PRACTICE

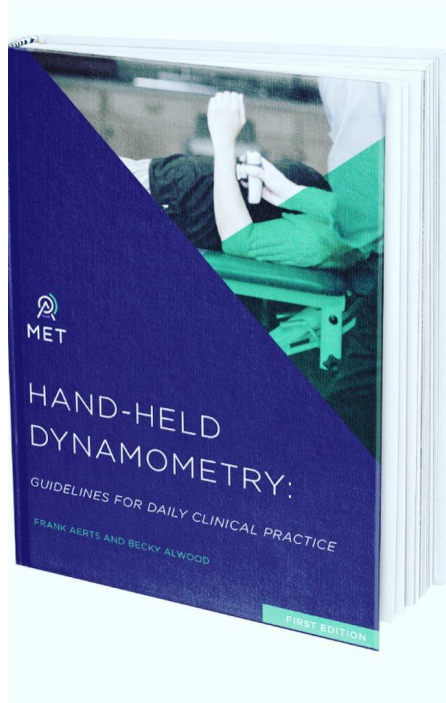


3 MEASUREMENT GROUPINGS

- Movement Bias
 - Most reliable
 - Strength Profiles
- Muscle Bias
 - Refined biomechanical examination
- Exercise Bias
 - Therapeutic exercise dosing
 - Functional strength profiles



HAND-HELD DYNAMOMETRY IN DAILY CLINICAL PRACTICE



3 MEASUREMENT TECHNIQUES

- Make - Technique
 - Most reliable
 - Strength Profiles
 - Force / time curve analysis
- Break - Technique
 - Non-compromised structure
 - Muscle bias test
- Break - Eccentric Technique
 - Therapeutic exercise design and dosing
 - Functional strength profiles / ratios



ELBOW FLEXION



ELBOW EXTENSION



UPPER QUADRANT CORE SET

< 60	Female	Male
N	60	33
Age	42 (12.4)	38 (13.2)
BMI	29.7 (7.6)	29.5 (6.6)
Grip	25.9 (9.9)	46.8 (10.3)

< 60	Female	Male
Elbow FLEX	12.2 (5.0)	22.0 (8.4)
Elbow EXT	10.1 (2.8)	18.7 (6.0)

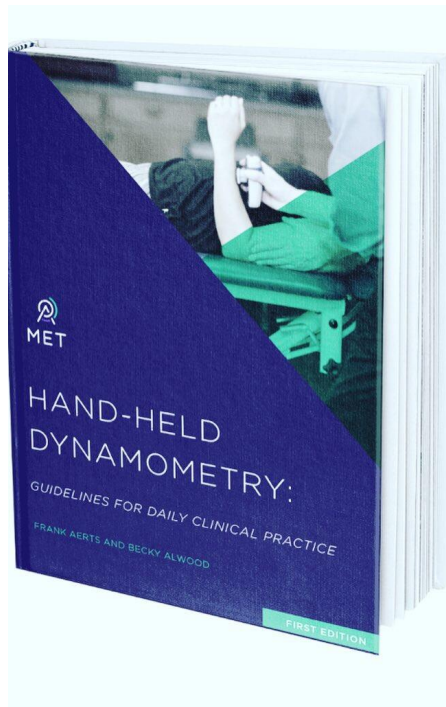
≥ 60	Female	Male
N	46	43
Age	67 (5.8)	69 (6.1)
BMI	28.1 (6.6)	29.2 (6.1)
Grip	23.6 (5.4)	39.2 (8.1)

≥ 60	Female	Male
Elbow FLEX	10.2 (4.0)	19.8 (5.7)
Elbow EXT	9.3 (2.3)	17.2 (5.0)

N pool >900, general outpatient practice; non-normalized data presented in: Mean, SD, kgf for HHD and grip measurements, age in years

	REFERENCE	UNIT	RIGHT		A/P RATIO 0.80 - 0.90	LEFT		A/P RATIO 0.80 - 0.90	LIMB RATIO 0.90 - 1.10	SYMMETRY DEFICIT
			AVERAGE	PEAK		AVERAGE	PEAK			
Grip (sit or supine)		kgf		26.0			24.9	0.96	4.23%	
Knee(sit) EXT		kgf		25.7			25.3	0.98	1.56%	
Shoulder FLEX		kgf		6.9			6.9	1.00	0.00%	
Shoulder EXT		kgf		5.8			5.9	1.02	1.69%	
Shoulder FLEX/EXT	0.90 - 1.30	Ratio		1.19			1.17			
Shoulder ABD		kgf		7.0			7.0	1.00	0.00%	
Shoulder ADD		kgf		4.7			4.7	1.00	0.00%	
Shoulder ABD/ADD	1.00 - 1.40	Ratio		1.49			1.49			
Shoulder ER		kgf		6.9			7.0	1.01	1.43%	
Shoulder IR		kgf		7.8			8.4	1.08	7.14%	
Shoulder ER/IR	0.65 - 0.85	Ratio		0.88			0.83			
Elbow FLEX		kgf		9.9			10.4	1.05	4.81%	
Elbow EXT		kgf		8.9			8.9	1.00	0.00%	
Elbow FLEX/EXT	1.20 - 1.60	Ratio		1.11			1.17			

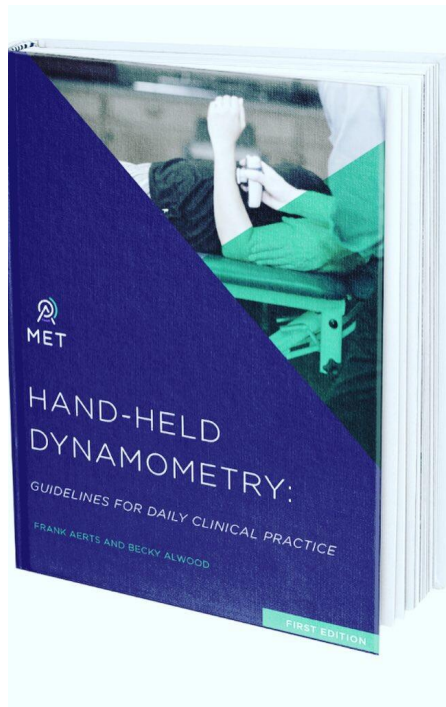
HAND-HELD DYNAMOMETRY IN DAILY CLINICAL PRACTICE



BICEPS BRACHII - LONG HEAD BIAS



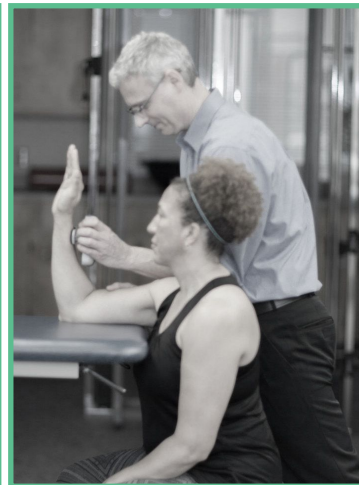
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BICEPS BRACHII
SHORT HEAD BIAS



BRACHIALIS



BRACHIORADIALIS



HAND-HELD DYNAMOMETRY IN DAILY CLINICAL PRACTICE

ASHT 2024 ANNUAL MEETING

September 26-29, 2024 | St. Louis, MO

Grip Strength Measurements Taken in Outpatient Physical Therapy Practice Compared to Established Norms: A Retrospective Observational Study

Frank Aerts, PT, DScPT, OCS
Becky Alwood, MHS, OTR/L
Bhupinder Singh, PT, PhD




INTEGRATING PERSPECTIVES: Learning, Collaborating and Innovating



Core Strength Profile

- . Grip
- . Knee extension (sitting at 90 degrees)
- . Ratio: (0.6) 0.7 - 1.1



Date (mm/dd/yy)
05/01/23

Identifier (max 15)
F-All Ages-480

Units
Metric (kg/kgf/cm)

Gender
Female

Age yrs
53

Height cm
164

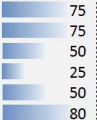
Weight kg
80

Dominant Side
Right


Involved Area

Involved Side
Left

STRENGTH PROFILE SCORE



	UNIT	ACTUAL	REFERENCE VALUE	REFERENCE RANGE	
Body Mass	kg	80.0		49.8	67.0
Body Mass Index	BMI	29.7		18.5	24.9
Maximum Grip Strength	kgf	26.0	28.1	21.9	34.5
Maximum Knee(sit) EXT Strength	kgf	25.7	38.8	22.7	38.1
Maximum Grip / Knee(sit) EXT	Ratio	1.01	0.72	0.70	1.10
Maximum Grip / Knee(sup) EXT	Ratio	1.41	0.90	0.90	1.30
Total Knee(sit) EXT / Body Mass	Ratio	0.64	>1.00		
Total Knee(sup) EXT / Body Mass	Ratio	0.45	>0.80		
Knee(sup) EXT / Knee(sit) EXT	Ratio	RIGHT 0.72	>0.80		
		LEFT 0.70	>0.80		





HAND-HELD DYNAMOMETRY IN DAILY CLINICAL PRACTICE



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Reliability of Hand-Held Dynamometry for Measuring Force Production in People with Parkinson's Disease

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Table 4 Correlation (r) and significance (p) between hand grip strength and force of UL muscle groups.

Muscle group	r (p)
Shoulder External Rotation	0.86 (0.001)
Elbow Flexion	0.86 (0.001)
Wrist Extension	0.84 (0.002)
Shoulder Adduction	0.82 (0.004)
Shoulder Internal Rotation	0.82 (0.004)
Shoulder Abduction	0.80 (0.005)
Wrist Flexion	0.78 (0.008)
Shoulder Extension	0.78 (0.008)
Elbow Extension	0.78 (0.008)
Knee Flexion	0.78 (0.007)
Shoulder Flexion	0.76 (0.01)

Grip ~ Upper Quadrant Strength Profile

- . Grip / Elbow flexion (N=200)
- . Correlation: >0.75
- . Ratio: 2.4 (0.9)
- . Elbow flexion is ~45% (15%) of grip strength

Knee extension (sit 90) ~ Lower Quadrant Strength Profile

