Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Research Summary – Hand-held dynamometer (HHD) – Upper Limb

Author Year Research Design Setting (country)	**Demographics and Injury Characteristics of Sample**	**Validity**	**Reliability**	**Responsiveness Interpretability**
Aufsesser et al. 2003 Reliability study using "make" technique bilaterally for biceps, triceps and wrist extension with individuals with SCI VA Health Care System, Spinal Cord Injury Unit, La Jolla, California	N=25 Mean (SD) age: 52 (16); range: 25-83 Average (SD) length of injury in years: 13 (10); range: 1-34 19 right-handed, 6 left-handed all subjects at least 1 year post-injury 11 paraplegic 14 tetraplegics		**Test-retest, Inter-rater, Intra-rater:** Reliability was examined across the three trials for each tester and the average of the trials was used to examine inter tester reliability. Make technique Intra-rater reliability – average of 3 trials: Tester 1 ICC=0.93-0.99 (95% confidence interval: 0.87-0.97) Tester 2 ICC=0.96-0.99 (95% confidence interval: 0.91-0.98) Single-trial reliability was slightly lower, but still acceptable in the majority of cases.	**Interpretability:** Root mean square error (RMSE) was calculated to determine if the measurement error was tolerable. Results indicated RMSE range for each tester for intra-rater reliability testing: Tester 1: 2.97-5.39 lb Tester 2: 1.72-3.15 lb Root mean square error (RMSE) was calculated to determine if the measurement error was tolerable. Results indicated RMSE range was very high (ranging from 5.70 lb for left triceps to 13.91 lb for right biceps).

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
			Intra-rater reliability coefficients (R): See table 1. Inter-rater reliability: ICC=0.21-0.89 In all cases, when the lower bound 95% CI was considered, these coefficients were not acceptable. Inter-rater reliability coefficient (R): See table 2.	Mean (SD) measurements, SEM and MDC for each tester: (SEM and MDC calculated from data in Aufsesser et al. 2003 – single-trial intra-rater used) See table 3.

Table 1. Intra-rater reliability coefficients (R):

	Tester 1		Tester 2	
Muscle	Average R	Single-trial R	Average R	Single-trial R
Left biceps	0.93	0.82	0.98	0.95
Right biceps	0.99	0.96	0.96	0.90
Left triceps	0.98	0.94	0.99	0.97
Right triceps	0.96	0.88	0.99	0.97
Left wrist extensors	0.98	0.96	0.99	0.97
Right wrist extensors	0.98	0.94	0.99	0.97

Table 2. Inter-rater reliability coefficient (R):

Muscle	Average R	Single-trial R

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability

Left biceps	0.36	0.22
Right biceps	0.21	0.11
Left triceps	0.89	0.80
Right triceps	0.74	0.59
Left wrist extensors	0.84	0.73
Right wrist extensors	0.84	0.72

Table 3.

	Tester 1			Tester 2		
Muscle	**mean (SD) measurement (lbs)**	**SEM (lbs)**	**MDC (lbs)**	**mean (SD) measurement (lbs)**	**SEM (lbs)**	**MDC (lbs)**
Left biceps	46.79 (11.91)	5.05	14.01	37.92 (8.23)	1.84	5.10
Right biceps	46.20 (14.70)	2.94	8.15	34.97 (9.37)	2.96	8.21
Left triceps	26.28 (11.90)	2.91	8.08	26.33 (12.51)	2.17	6.01
Right triceps	30.74 (9.41)	3.26	9.04	27.21 (14.09)	2.44	6.76
Left wrist extensors	32.80 (13.55)	2.71	7.51	23.26 (10.00)	1.73	4.80
Right wrist extensors	31.39 (11.99)	2.94	8.14	23.05 (10.52)	0.26	0.73

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Burns et al. 2005 Repeated-measures	N=19 (all men) Mean (SD) age: 53.5 (11.7)		**Test-retest, intra-rater, inter-rater:** For both make and break techniques, strength	**Interpretability:** The break technique produced significantly greater strength measurements than

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
examining reliability of HHD for elbow flexor or extensors Inpatient spinal cord injury unit	3 undergoing initial SCI rehabilitation (<6 months post-injury) 16 were >1 year post-injury Motor level: C4 – N=1 C5 – N=12 C6 – N=6 AIS scores: A – N=6 B – N=3 D – N=10 inclusion criteria: weakness of either the elbow flexor or extensor (MMT grade: 3 or 4 out of 5)		measurements showed high reliability for both interrater and intrarater reliability comparisons. Se table 1. For these intra-rater comparisons, the mean difference in strength between the two sessions averaged between 1.0 and 1.5 kg. Within-participant standard deviation for the intrarater comparisons ranged from 0.8 to 1.3 kg, with no significant difference between make and break technique. The corresponding range for repeatability, 2.5–3.5 kg, indicates the maximum expected	did the make technique. We calculated this difference as the break/make (B/M) ratio. B/M ratios showed considerable variability between participants, and there was no significant difference in mean B/M ratios determined by the two examiners. For examiner 1, mean (SD) B/M was 1.41 (0.39) in session 1 and 1.48 (0.38) in session 2, with corresponding values of 1.38 (0.29) and 1.49 (0.37) for examiner 2. We found no association between the B/M ratio and either the DTR or MAS for the test muscle.

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
			difference between two repeated measurements for 95% of paired observations. Within-participant standard deviation for the inter-rater comparisons ranged from 0.9 to 1.1 kg, with repeatability of between 2.6 and 2.9 kg, and there was no significant differences between repeatability for make and break techniques. Plots of differences between strength measurements for intra-rater and inter-rater comparisons showed no evidence of improved agreement later in the study, after the examiners gained	

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	**Demographics and Injury Characteristics of Sample**	**Validity**	**Reliability**	**Responsiveness Interpretability**
			experience with HHD.	

Table 1.

	ICC:	**95% confidence interval:**
Intra-rater reliability:	--	--
Examiner 1 make	0.91	0.79-0.97
Examiner 2 make	0.94	0.86-0.98
Examiner 1 break	0.94	0.86-0.98
Examiner 2 break	0.93	0.82-0.97
Inter-rater reliability:	--	--
Examiner 1 make	0.94	0.86-0.98
Examiner 2 make	0.97	0.93-0.99
Examiner 1 break	0.95	0.87-0.98
Examiner 2 break	0.94	0.86-0.98

Author Year Research Design Setting (country)	**Demographics and Injury Characteristics of Sample**	**Validity**	**Reliability**	**Responsiveness Interpretability**
May et al. 1997 Repeated measures examining reliability of HHD for shoulder rotation	N=25 (21M, 4F) Mean (SD) age 26.6 (6.5) yrs (range 18-42yrs) 12 tetraplegia, 13 paraplegia. 22 traumatic SCI, 3 other (spina bifida, polio, tumor).	*The averages of three HHD measurements were compared to the averages of four trials with an isokinetic dynamometer.* **Pearson correlation coefficient.**	**Test-retest, inter-rater, intra-rater:** *Break test repeated three times for internal and external rotation on right and left shoulder. (All testing completed in one session.)*	**Interpretability:** See table 1.

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Private practice clinic	Mean (SD) DOI 8.1 (6.9) yrs. Selected from various community groups.	All correlations were significant (P<.0001 for whole group comparisons; P<.01 for groups by SCI type). External rotation: all r=0.86, paraplegics r=0.83, tetraplegics r=0.56 Internal rotation: all r=0.88, paraplegics r=0.74, tetraplegics r=0.52 The Pearson product moment correlation as calculated for the combined data of all subjects was .88 for internal rotation and .86 for external rotation. Both correlations were significant at the p < .0001 level, indicating a good relationship between the HHD and	**Intra-rater reliability assessed with ICC. Brackets indicate 95% confidence interval.** External rotation: all ICC=0.94 (.91-.96), paraplegics ICC=.89 (.80-.94), tetraplegics ICC=.93 (.86-.96) Internal rotation: all ICC=.96 (.94-.98), paraplegics ICC=.92 (.86-.96), tetraplegics ICC=.89 (.81-.94)	

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
		Cybex measurements. Separate analyses of the paraplegia and tetraplegia data found significant correlations ($p < .01$); however, the coefficients for the data of the persons with tetraplegia were considerably lower than those calculated for the persons with paraplegia.		
	Table 1. Mean (SD) hand-held dynamometer measurements in kg for different shoulder movements:			

Shoulder movement	mean (SD) measurement (kg)
External rotation (all subjects)	16.8 (7.3)
Internal rotation (all subjects)	22.8 (9.9)
External rotation (paraplegia)	21.5 (6.4)
External rotation (tetraplegia)	11.7 (4.5)
Internal rotation (paraplegic)	30.1 (6.9)
Internal rotation (tetraplegia)	14.8 (5.5)

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Lamontagne et al. 1998 Methodological study. Inter-trial reliability of resistive torque measurements obtained w/ hand-held and isokinetic dynamometers were compared. Validity of hand-held dynamometer for assessment of spastic hypertonia was tested. Plantar flexors were stretched w/ an isokinetic dynamometer while evaluator tried to match	N=9 (6M, 3F) Mean age 40.6±10.5yrs (range 21-54yrs) All were subjects in an ongoing separate clinical trial. T6-10 Injury duration 1-5yrs. 7 complete, 2 incomplete 8 traumatic, 1 ischemic Ashworth score ≥1		**Test-retest, Intra-rater, Inter-rater:** *Resistive torque upon stretch of the plantar flexors was measured using a hand-held dynamometer (HHD) or a Kin-Com Isokinetic Dynamometer (ID). Ankle stretch was performed at set high (180°/s) or low (5°/s) velocities (this was estimated manually with the HHD).* **Intraclass correlation coefficients.** HHD: ICC's for movements at low velocity were similar whether all	

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
velocities with a hand-held dynamometer. EMG of soleus and tibialis anterior muscles were taken. Neurobiology Research Centre, Quebec, Canada			trials were included (n=5; ICC=0.93) or the first trial was excluded (n=4; ICC=0.94). ICC's for movements at high velocity were also similar when all trials were included (ICC=0.84) or the first trial was excluded (ICC=0.81), but were lower than low velocity ICC's. ID: ICC's were higher when the first trial was excluded (low velocity: ICC=0.99; high velocity: ICC=0.93) compared to when it was included (low velocity: ICC=0.83; high velocity: ICC=0.75). Similar to HHD, ICC's were	

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
			lower for the high velocity movements. **Intertrial variability was expressed with Coefficients of variation (as a percentage) using the last four trials.** CV's were generally higher for the HHD method compared to the ID method. Resistive torque: Low velocity CV=7.98 (HHD) and CV=3.14 (ID) High velocity CV=16.11 (HHD) and CV=6.43 (ID) Velocity:	

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
			Low velocity CV=40.43 (HHD) and CV=7.84 (ID) High velocity CV=12.74 (HHD) and CV=0.47 (ID)	
Jacquemin et al. 2004 Methodological study. Tests Maximal isometric contractions of intrinsic hand muscles (second-digit abductors, fifth-digit abductors and thumb opposers) via the "break" method 3 times each. 4 analysis methods:	N=55 31 AB subjects (17M, 14F) Mean age = 37.7yrs 29 right-hand dominant 24 subjects with SCI (23M, 1F) Mean age = 53.5yrs 16 right-hand dominant, 2 left-hand dominant, 6 unknown AB subjects were recruited at the veterans affairs. SCI subjects were in- or out-patients of the VA SCI Service.	*Strength measurements compared to those obtained with Manual Muscle Test (MMT; graded scores from 0 to 5).* Scores by these two methods were positively correlated, but were nonlinear with a marked dispersion of values at MMT grades 3, 4 and 5. This indicates a lack of sensitivity of the MMT method at those higher strength ranges, whereas myometry detected	**Intra-rater, inter-rater, Test-retest:** *Bilateral measurements were made by two testers, three times each for each of the muscle groups (second digit abductors, fifth digit abductors and thumb opposers).* **Bland-Altman plotting method.** Inter-rater differences varied with the level of strength (more variance at higher strength), but differences relative	

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
1) max strength 2) median value of all 3 measure ments 3) mean value of all 3 measure ments 4) mean of the 2 highest measure ments were evaluated for reliability. VA SCI Service Veterans Affairs	9 had paraplegia, 14 had tetraplegia. Etiology of injury included cervical myelopathy or peripheral neuropathy due to median or ulnar nerve entrapment	changes within this range.	to strength were similar except at strength levels below 1.0kg. Values below 1.0kg were excluded for 95% interval calculation. The mean of the highest of 2 of 3 trials was used to define the upper limit (95th percentile) of normal inter-rater differences with 29.3, 38.5 and 43.7% for second digit abductor (2nd abd)., fifth digit abductor (5th abd) and thumb opposition (1st opp), respectively. This study suggests that serial strength differences exceeding these values are likely to represent significant	

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
			changes in muscle strength. 95th Percentile of Interraters differences Max strength: 35.8 (2nd adb), 40.0 (5th abd), 43.7 (1st opp) Mean of 2 highest: 29.6 (2nd adb), 38.5 (5th abd), 43.7 (1st opp) Mean of 3: 29.3 (2nd adb), 35.0 (5th abd), 38.6 (1st opp) Median of 3: 31.9 (2nd adb), 40.0 (5th abd), 43.7 (1st opp)	
Herbison et al. 1996 Methodological study. Compares changes in strength after	N=88 (78M, 10F) Mean age=34yrs, range 15-68yrs. Level of injury C4-8. Frankel grades A-D. Inclusion criteria:	*Hand held myometry (MYO) and manual muscle testing (MMT) were performed at various intervals between 72h to 2 years post-SCI. Groups were based on changes (half or full*	**Test-retest, Inter-rater, Intra-rater:** Inter-rater reliability for myometer testing was 0.82.	

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	**Demographics and Injury Characteristics of Sample**	**Validity**	**Reliability**	**Responsiveness Interpretability**
SCI with the use of a hand-held myometer to the manual muscle test (MMT). Tests elbow flexor muscles. Data collection times post-SCI were determined to be 72 h; 1, 2, 3 weeks; and 1, 2, 3, 6, 12, 18 and 24 months post spinal cord injury. Regional SCI Centre of the Delaware Valley (patients recruited b/w 1988 and 1993).	Minimal manual muscle test (MMT) of 3.5 on one side.	*grade) from initial to later MMT score. For each interval, the later MYO measurement (MY02) was divided by the earlier (MYOI). The result was multiplied by 100 to obtain a value which expressed the later strength of contraction as a percent of the earlier examination.* **Student t-tests were used to compare MYO1 and MYO2 values. Measures were expressed as geometric means (GM; MYO2/MYO1 x 100) and coefficients of variation of these % changes (CV).** MYO was more sensitive than MMT in detecting strength		

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
		changes. Values indicate (GM-1 CV; GM; GM+1CV; significance level). a) Two of the three groups that had no change in MMT scores had significant changes in MYO scores – MMT=4.0 (80; 140; 243; $p<0.05$), MMT=4.5 (84; 126; 187; $P<.01$). b) There were also larger changes indicated by MYO for groups that made a half grade change in MMT scores – MMT=3.5-4.0 (123; 205; 342; $P<.002$), MMT=4.0-4.5 (82; 139; 234; $P<.02$) and MMT=4.5-5.0 (84; 126; 187; $P<.02$).		

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
		c) There were also larger changes indicated by MYO for groups that made a full grade change in MMT scores – MMT=3.5-4.5 (127; 232; 424; P<.05) and MMT=4.0-5.0 (126; 191; 292; P<.001).		
Noreau & Vachon 1998 Methodological study. Purpose is to compare three methods for measuring upper limb muscle strength in individuals with SCI: the manual muscle test (MMT), the hand-held myometry and	N=38 (31M, 7F) Paraplegia group: (N=23) mean age = 28.2±13.9yrs 18M 5F AIS level at admittance: A-15, B-3, C-1, D-4 Mean DOI at admittance: 1.6±0.7mo Tetraplegia group: (N=15) mean age = 30.1±13.4yrs	*Measured elbow extension and flexion, shoulder extension and flexion, and shoulder adduction and abduction. The three tests were separated by at least one day and were all performed within a week.* *Manual muscle test (MMT) – graded from 0 to 5* *Hand-held myometer (HHM) – avg of three*		

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	**Demographics and Injury Characteristics of Sample**	**Validity**	**Reliability**	**Responsiveness Interpretability**
the isokinetic dynamometry (Cybex). Muscles tested were elbow flexors-extensors, shoulder flexors-extensors and shoulder abductors-adductors on the stronger side. The three procedures were performed at least 1 day apart over the course of 1 week. Rehabilitation Institute (Quebec City)	13M 2F AIS level at admittance: A-6, B-6, C-3, D-0 Mean DOI at admittance: 2.1±2.1mo	*trials for each muscle group* *Isokinetic dynamometry (ID) - 60°/sec, tested stronger side of body* **Spearman correlations for comparison of MMT and HHM.** Paraplegics r=0.26-0.67 Tetraplegics r=0.50-0.95 Highest correlations were for elbow extension and shoulder flexion and adduction in tetraplegics at admittance (r=0.95, 0.83, 0.84, respectively). The majority of correlations decreased at time of discharge.		

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
		Spearman correlation coefficients between the strength values measured by MMT and myometry for six muscle groups (tested on both sides) in individuals with SCI (n=38): See table 1. **Spearman correlations for comparison of MMT and ID.** Paraplegics r=0.19-0.65 Tetraplegics r=0.35-0.95 **Pearson correlations for comparison of HHM and ID.** Paraplegics r=0.70-0.90 Tetraplegics r=0.57-0.96		

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
		Lowest correlations were for elbow extension and shoulder abduction (paraplegics) and shoulder extension and abduction (tetraplegia). These correlations increased at discharge (as well as shoulder adduction in paraplegics). Pearson correlation coefficients between the strength values measured by myometry and ID on 6 muscle groups (tested on stronger side) in individuals with SCI (n=38): See table 2.		

Table 1.

	Paraplegia (n=23)		**Tetraplegia** (n=15)	
Muscles:	**Admittance**	**Discharge**	**Admittance**	**Discharge**
Elbow flexors	0.48	0.26**	0.58	0.48*

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	**Demographics and Injury Characteristics of Sample**	**Validity**	**Reliability**	**Responsiveness Interpretability**

Elbow extensors	0.46	0.55	0.95	0.88
Shoulder flexors	0.63	0.60	0.83	0.50*
Shoulder extensors	0.44*	0.49	0.67	0.57
Shoulder abductors	0.64	0.57	0.55*	0.59
Shoulder adductors	0.67	0.34*	0.84	0.73

Table 2. Pearson correlation coefficients between the strength values measured by myometry and ID on 6 muscle groups (tested on stronger side) in individuals with SCI (n=38):

	Paraplegia (n=22, missing one value)		**Tetraplegia**	
Muscles:	**Admittance**	**Discharge**	**Admittance**	**Discharge**
Elbow flexors	0.76	0.75	0.81	0.75
Elbow extensors	0.70	0.82	0.92	0.96
Shoulder flexors	0.89	0.89	0.82	0.78
Shoulder extensors	0.85	0.83	0.59*	0.87
Shoulder abductors	0.73	0.82	0.57*	0.76
Shoulder adductors	0.81	0.90	0.91	0.90

Schwartz et al. 1992 Case series	N=122 individuals with quadriplegia (all male) Age range: 15-70 yrs old Frankel grades A-D	Spearman rank correlation coefficients were performed looking at the MMT and	**Test-retest, Inter-rater, Intra-rater:** Sequential motor strength examination using both MMT and hand-	**Interpretability:** See table 2.

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
Purpose was to determine the relationship between the manual muscle test (MMT) and hand-held myometry and to define a range of myometry values that could be correlated with discrete MMT grades. Hospital and home	Neurological level: C4-6	myometry measurements. Of the 24 correlation obtained between the two measures, 22 were significant ($p<0.001$). Correlations ranged from 0.59 to 0.94. The 2 non-significant correlations occurred at 12 months for the right biceps (r=.18) and left biceps (r=.42). Spearman rank correlation between MMT and Myometry: time post SCI See table 1. Correlation analysis found both modalities were measuring the strength of the muscle, but the myometry measured	held myometry were performed at 72 hours, 1 and 2 weeks and 1, 2, 3, 4, 6, 12, 18 and 24 months post-injury. Inter-rater reliability for all muscles tested was r=0.94.	

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability
		more subtle changes in muscle strength. MMT data has a smaller increase from date of injury to 24 months post-injury, while myometry data reflect a steady increase in strength. This suggests that the MMT cannot detect small changes in strength. Schwartz proposes that this is because in order to receive a grade of 3.0 by the MMT method, only a small fraction of the motor neurons need to be functional while MMT strength grades above a 3.0 require activation of the majority of the remaining neurons.		
	Table 1.			

Reviewer ID: Carlos L. Cano Herrera

Last updated: March 1st, 2024

Author Year Research Design Setting (country)	Demographics and Injury Characteristics of Sample	Validity	Reliability	Responsiveness Interpretability

Muscle:	72 hours	1 week	1 month	3 months	6 months	12 months
Left bicep	0.86	0.84	0.68	0.82	0.59	0.42
Right bicep	0.80	0.83	0.79	0.68	0.59	0.18
Left ECR	0.92	0.86	0.81	0.84	0.84	0.77
Right ECR	0.94	0.78	0.93	0.79	0.75	0.71

Table 2. Mean (SD) myometry data grouped by MMT score:

	Acute period (72 h-2 weeks)				Rehabilitation period (2mo – 3mo)			
MMT score:	Left bicep	Right bicep	Left ECR	Right ECR	Left bicep	Right bicep	Left ECR	Right ECR
2.5-3.5	2.8 (1.7)	2.4 (2.7)	2.9 (1.8)	2.1 (1.3)	5.1 (2.8)	5.8 (5.3)	5.0 (2.4)	3.7 (1.3)
4.0	2.8 (1.5)	5.6 (2.2)	4.8 (1.1)	3.5 (2.1)	8.6 (2.6)	12.2 (1.1)	8.6 (2.0)	8.7 (6.9)
4.5-5.0	8.9 (4.2)	8.7 (4.4)	6.2 (3.3)	7.3 (4.2)	9.5 (3.2)	10.2 (3.9)	10.8 (0) *n=1	6.2 (2.0)