NeuroFlexor reference data from >100 healthy adult subjects

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NeuroFlexor

NeuroFlexor → quantification → neural (spasticity)

quantification → non-neural component of the resisting force

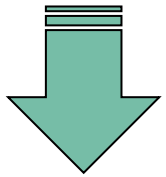
Valid, highly reliable and sensible to change method

Lindberg PG et al. Validation of a new biomechanical model to measure muscle tone in spastic muscles. Neurorehabil Neural Repair. 2011 Sep;25(7):617-25
Gäverth J et al. Test-retest and inter-rater reliability of a method to measure wrist and finger spasticity. J Rehabil Med. 2013 Jul;45(7):630-6
Gäverth J et al. Sensitivity of the NeuroFlexor method to measure change in spasticity after treatment with botulinum toxin A in wrist and finger muscles. J Rehabil Med. 2014 Jul;46(7):629-34

Aims of the project

The *primary aim* was to explore with the NeuroFlexor method the different components of resisting force in a healthy population.

The *second aim* was to use the established cut-off values to detect early signs of spasticity in a group of recovering stroke patients.



Important role in development of early targeted rehabilitative treatments.

Materials and Methods

Part 1 - Establishing normative and cut-off values of spasticity

- 107 healthy adult subjects
- Exclusion criteria:
  - neurological diseases
  - disorders of the hand
  - fractures of upper limb in the previous 6 months
  - presence of pacemaker or other stimulators
  - pregnancy

	Distributions, *n=107*
Age, years	
Mean (SD)	44.49 (13.99)
Min – Max	20 – 68
Gender, n	
Male	52
Female	55
Range of age, n	
20-29	17
30-39	23
40-49	27
50-59	19
60-70	21
Dominant hand, n	
Right	94
Left	13

Materials and Methods

Part 2 - Use of normative cut-off values for early detection of spasticity in post-stroke patients

39 post-stroke patients (13 females and 26 males; age 33-69 years, with mean 55.4)

- Inclusion criteria:
  - first ever stroke
  - clinical diagnose of arm paresis
- Exclusion criteria:
  - other neurological or rheumatologic disorders of hand
  - cerebellar lesions

Study design

- ✓ Health status questionnaire
- ✓ Anthropometric measurements of the subjects
- ✓ Passive Range of motion
- ✓ Maximal grip strength
- ✓ Clinical assessment of upper limb function in post-stroke patients
- ✓Assessment dominant hand / impaired upper limb with NeuroFlexor

Results

Part 1 - Establishing normative and cut-off values of spasticity

	Minimum	Maximum	Mean	Std. Deviation	Cut-off (mean+3SD)
NC *	-0.99	3.02	0.80	0.87	3.398
EC *	-0.41	5.66	2.66	1.11	5.998
VC *	-0.25	1.26	0.28	0.27	1.082
Total Resistance *	1.59	6.64	3.89	1.07	7.091
P0 *	2.71	8.46	5.88	1.03	8.971

**Newton*

Elevated values of neural, elastic and viscous components were defined pathological if above the reference limits obtained by adding three standard deviation to mean.

Results

Part 1 - Establishing normative and cut-off values of spasticity

Pearson Correlation

	Age	Passive ROM	Grip force test	NC	EC	VC	Total Resistance	P0
Age	1	-0.235*	-0.044	0.081	-0.302**	0.220*	-0.169	0.241*
Passive ROM	-0.235*	1	-0.048	-0.109	0.090	-0.146	-0.015	-0.062
Grip force test	-0.044	-0.048	1	0.211*	0.327**	0.124	0.548**	0.255**
NC	0.081	-0.109	0.211*	1	-0.451**	-0.226*	0.124	0.108
EC	-0.302**	0.090	0.327**	-0.451**	1	0.092	0.759**	-0.050
VC	0.220*	-0.146	0.124	-0.226*	0.092	1	0.174	0.292**
Total Resistance	-0.169	-0.015	0.548**	0.124	0.759**	0.174	1	0.155
P0	0.241*	-0.062	0.255**	0.108	-0.050	0.292**	0.155	1

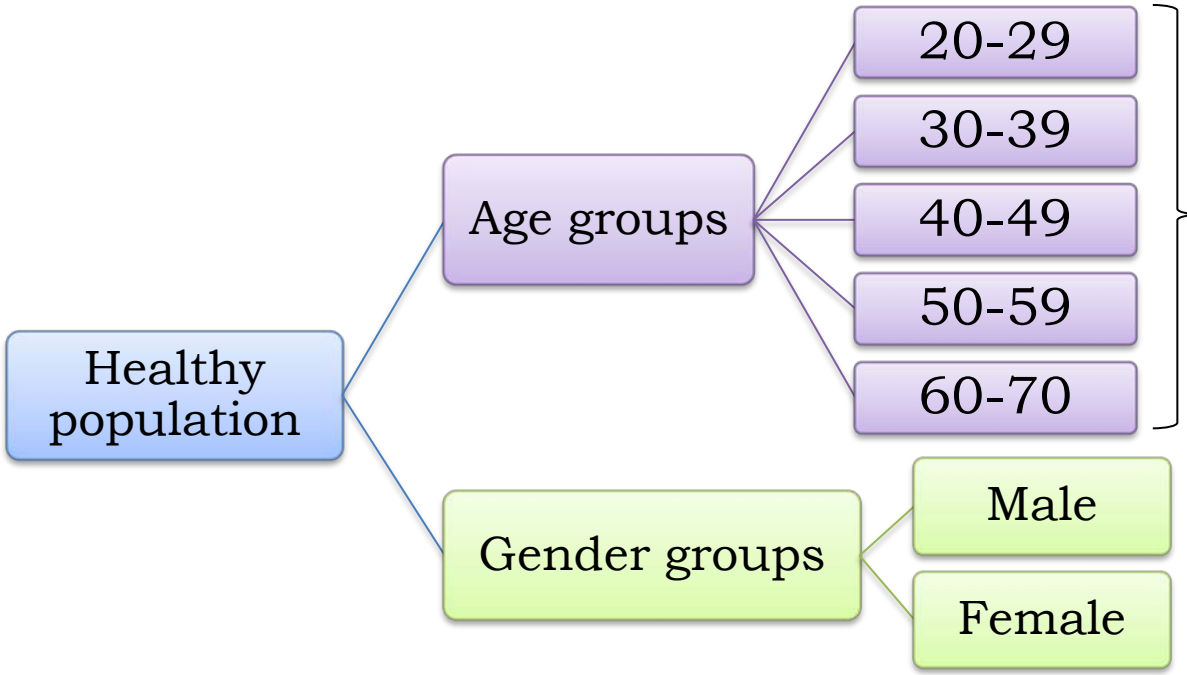
**. Correlation is significant at the 0.05 level*

***. Correlation is significant at the 0.01 level*

Results

Part 1 - Establishing normative and cut-off values of spasticity

One-Way ANOVA

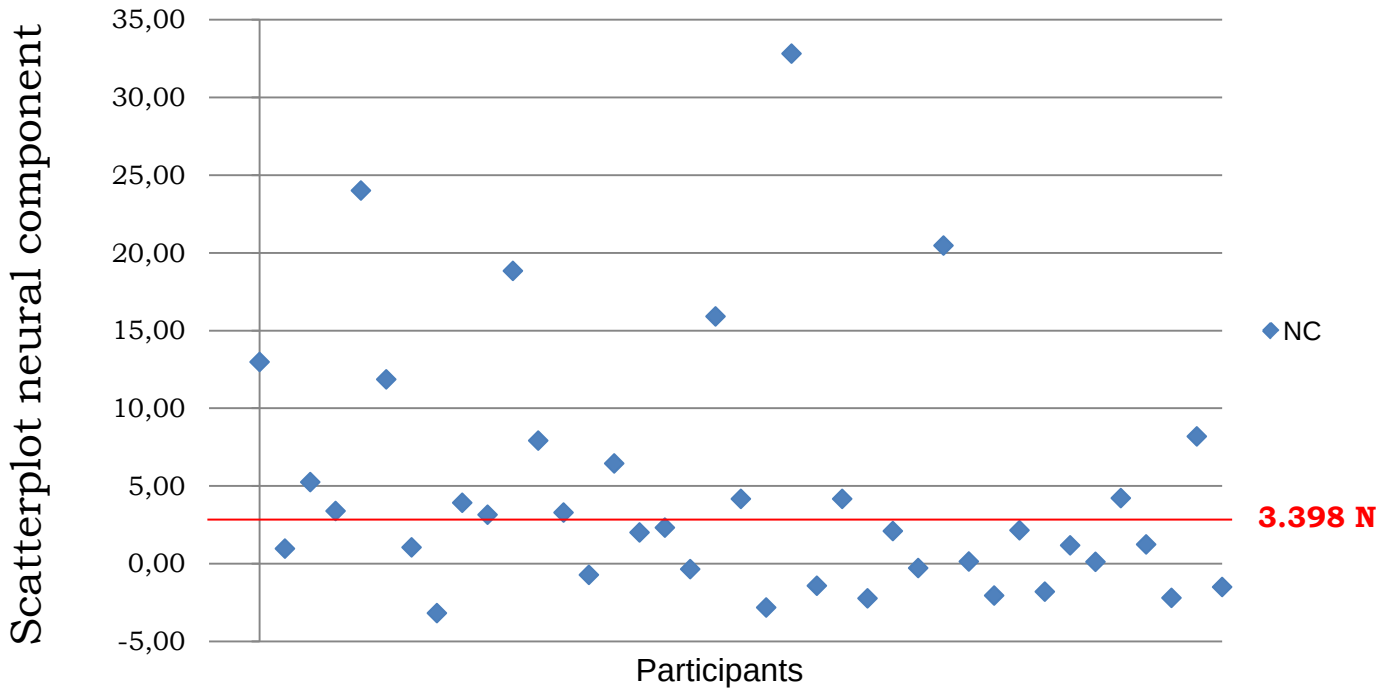


Differences in elasticity, viscosity and resting tension (P0)

EC and P0 were higher in males compared to females

Results

Part 2 - Use of normative cut-off values for early detection of spasticity in post-stroke patients



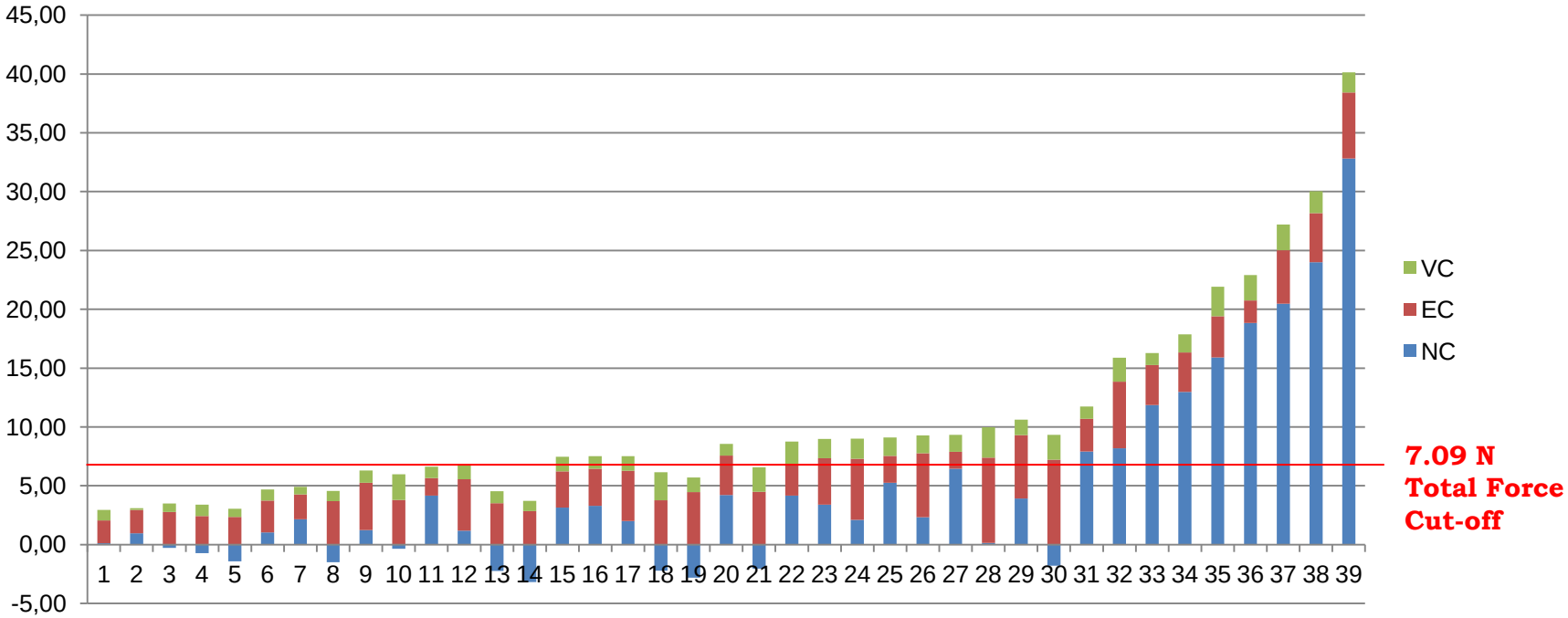
39 post-stroke patients → 16 with pathological NC

→ 2 with pathological EC

→ 23 with pathological VC

Results

Individual profiles of NeuroFlexor components in post stroke population



Elasticity was the major contributor in healthy subjects while an increase in passive resistance in post-stroke patients was predominantly neural in origin.

Conclusion

Our study demonstrates that NeuroFlexor method is able to explore the neural and non-neural components of the force resisting passive hand extension.

It provides applicable reference values for measurements with NeuroFlexor and also demonstrates its usefulness in detection of spasticity in the early phase of recovery after stroke.

Thank you for your attention!

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