Gravi disabilità motorie e alterazioni muscolo-scheletriche:

La presa in carico riabilitativa

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Novara

Frontiers in Neurology > Neurorehabilitation > Research Topics > Long Term Disability in Neurolo...

Long Term Disability in Neurological Disease: A Rehabilitation Perspective

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Editorial: Long term disability in neurological disease: A rehabilitation perspective

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frontiers | Frontiers in Neurology

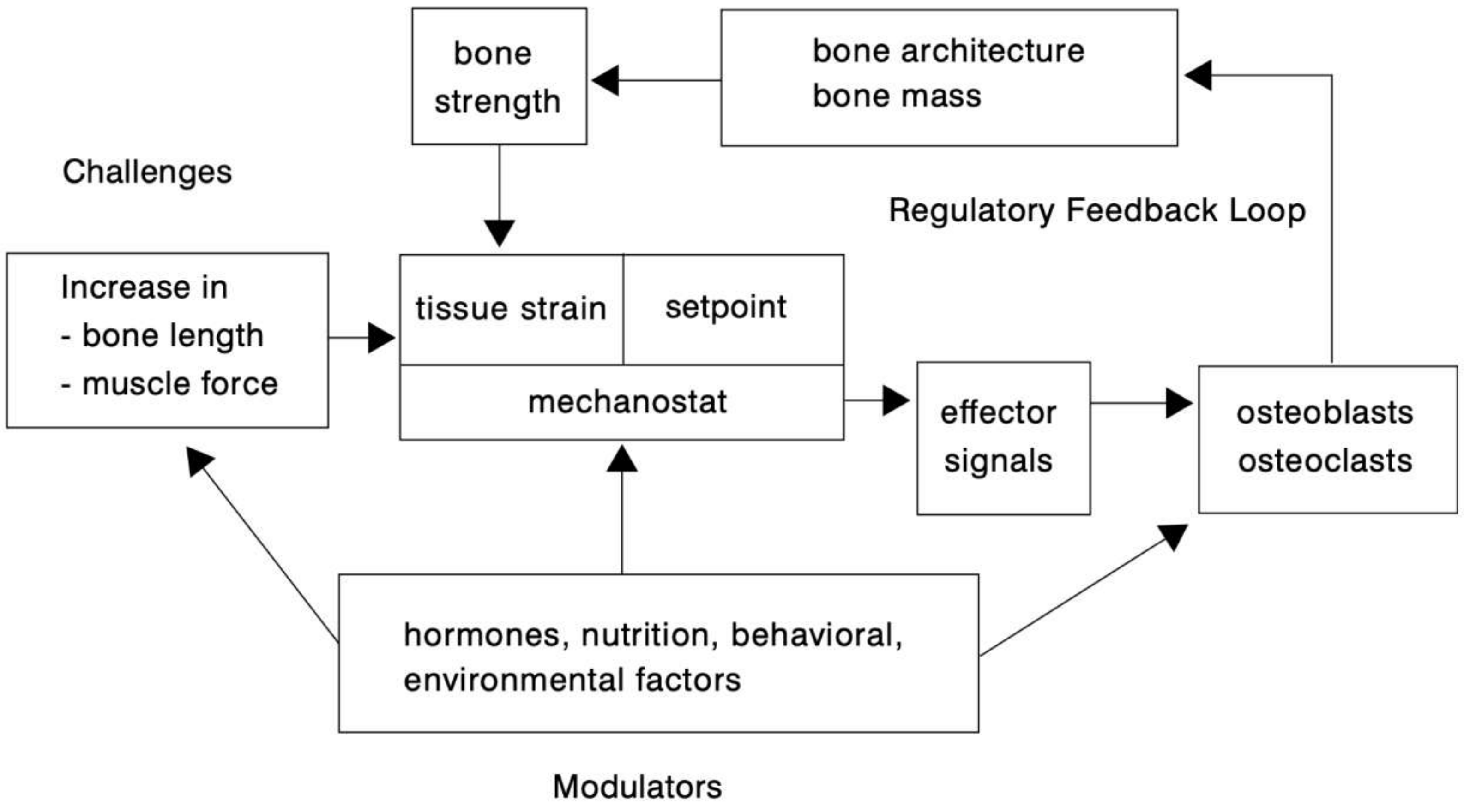
TYPE Editorial
PUBLISHED 17 August 2022
DOI 10.3389/fneur.2022.964664

J Musculoskelet Neuronal Interact 2005; 5(3):232-238

Review Article

From mechanostat theory to development of the "Functional Muscle-Bone-Unit"

E. Schoenau



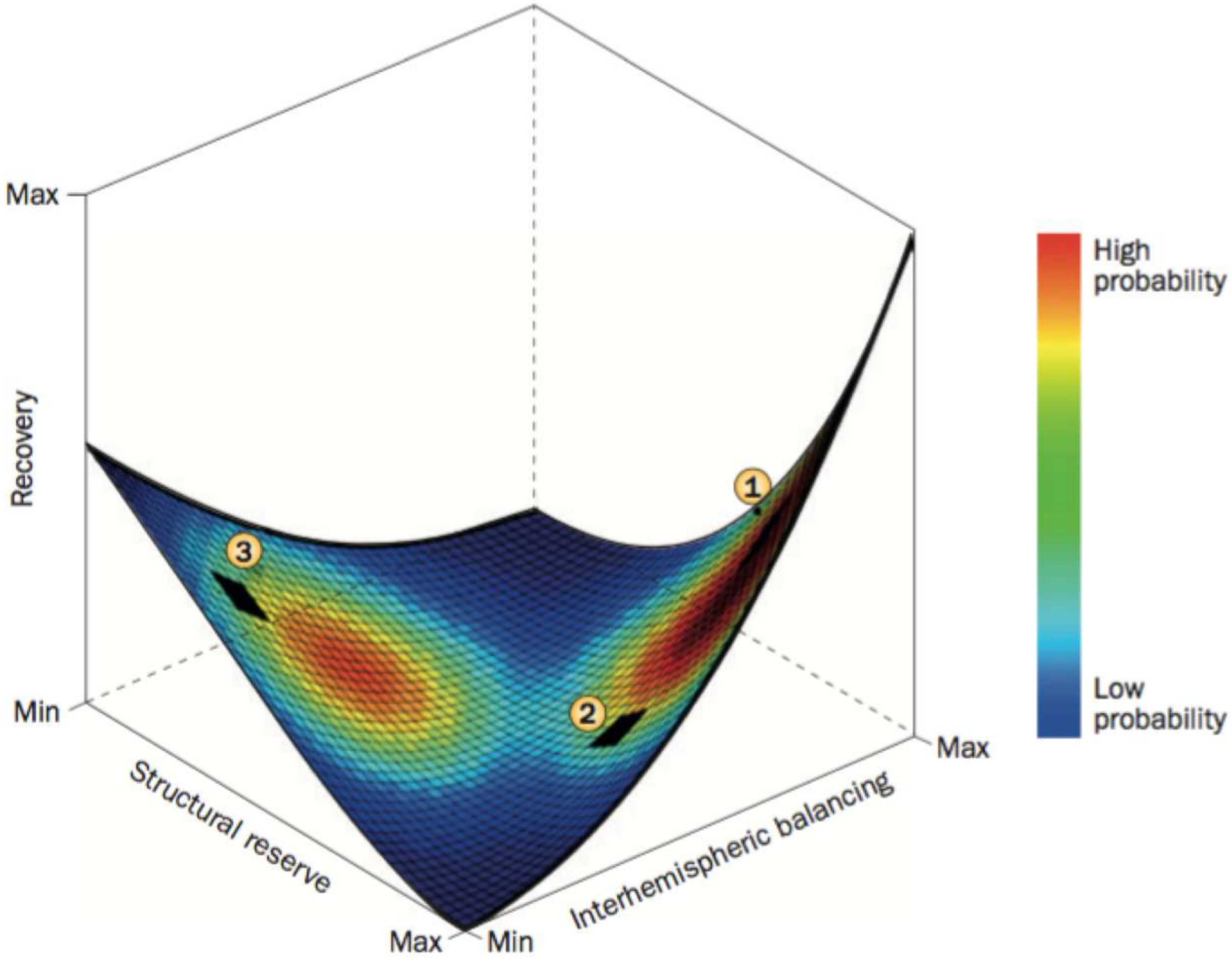
Functional Neurology 2018;33(2):65

Editorial

Chronic stroke: an oxymoron or a challenge for rehabilitation?

Alessio Baricich, MD, PhDa, Stefano Carda, MD, PhDb

a Physical and Rehabilitation Medicine, Department of Health Sciences, Università del Piemonte Orientale, Novara, Italy
b Département de Neurosciences cliniques, Service de Neuropsychologie et Neuroréhabilitation, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland



Di Pino et al, Nat Rev Neurol 2014

Aging after stroke: how to define post-stroke sarcopenia and what are its risk factors?

Sheng LI, Javier GONZALEZ-BUONOMO, Jaskiran GHUMAN, Xinran HUANG, Aila MALIK, Nuray YOZBATIRAN, Elaine MAGAT, Gerard E FRANCISCO, Hulin WU, Walter FRONTERA

European Journal of Physical and Rehabilitation Medicine 2022 Sep 05
DOI: 10.23736/S1973-9087.22.07514-1

- Sarcopenia varied between 18% and 25% depending on the diagnostic criteria used.
- A significant difference was seen in the prevalence of low hand grip strength on the affected side (96%) when compared to the contralateral side (25%).
- The prevalence of slow gait speed was 86% while low ASM was present in 89% of the subjects.
- ASM loss, bone loss and fat deposition were significantly greater in the affected upper limb than in the affected lower limb.
- **Time since stroke was a factor associated with bone and muscle loss in the affected upper limb**

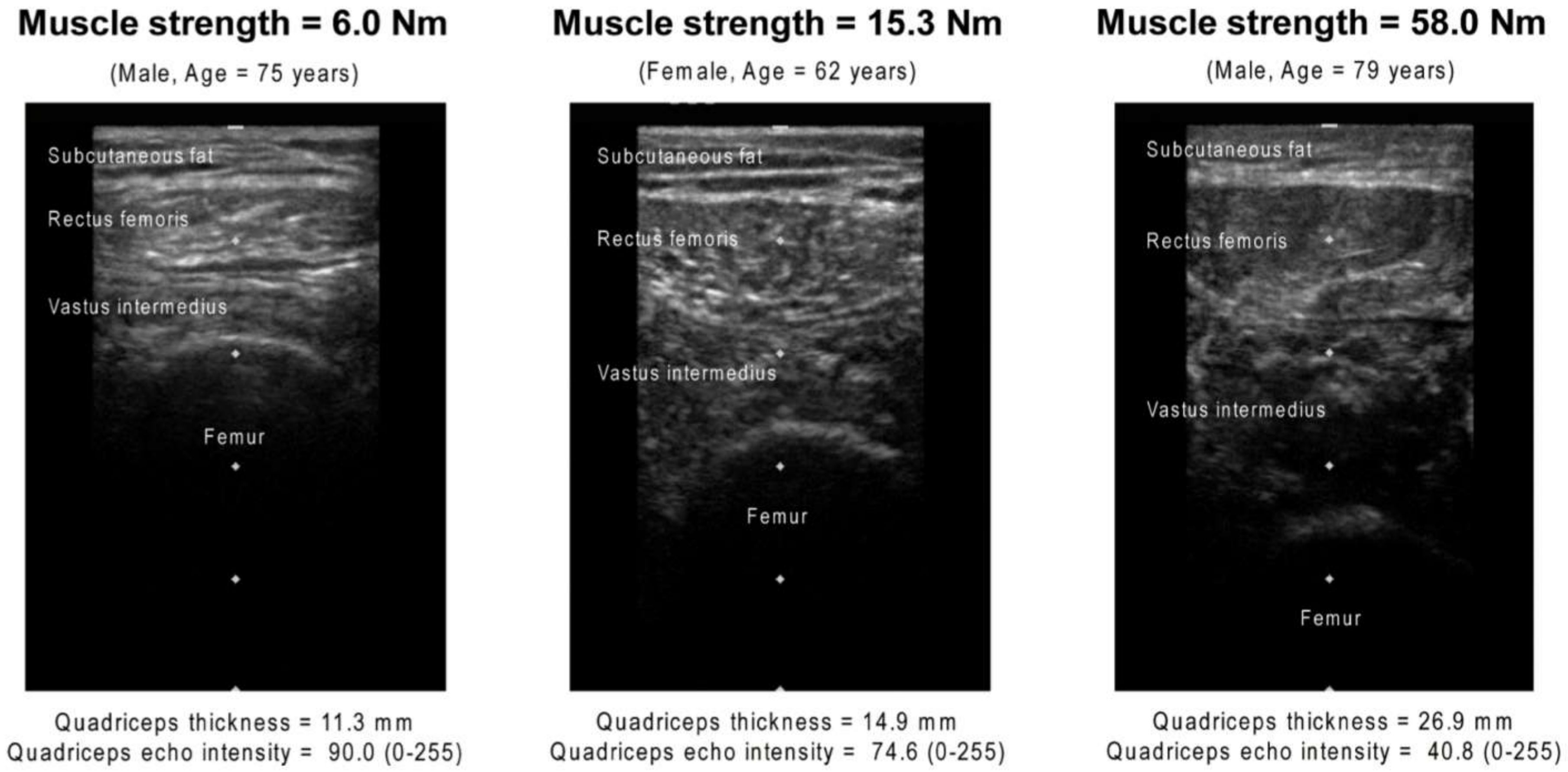
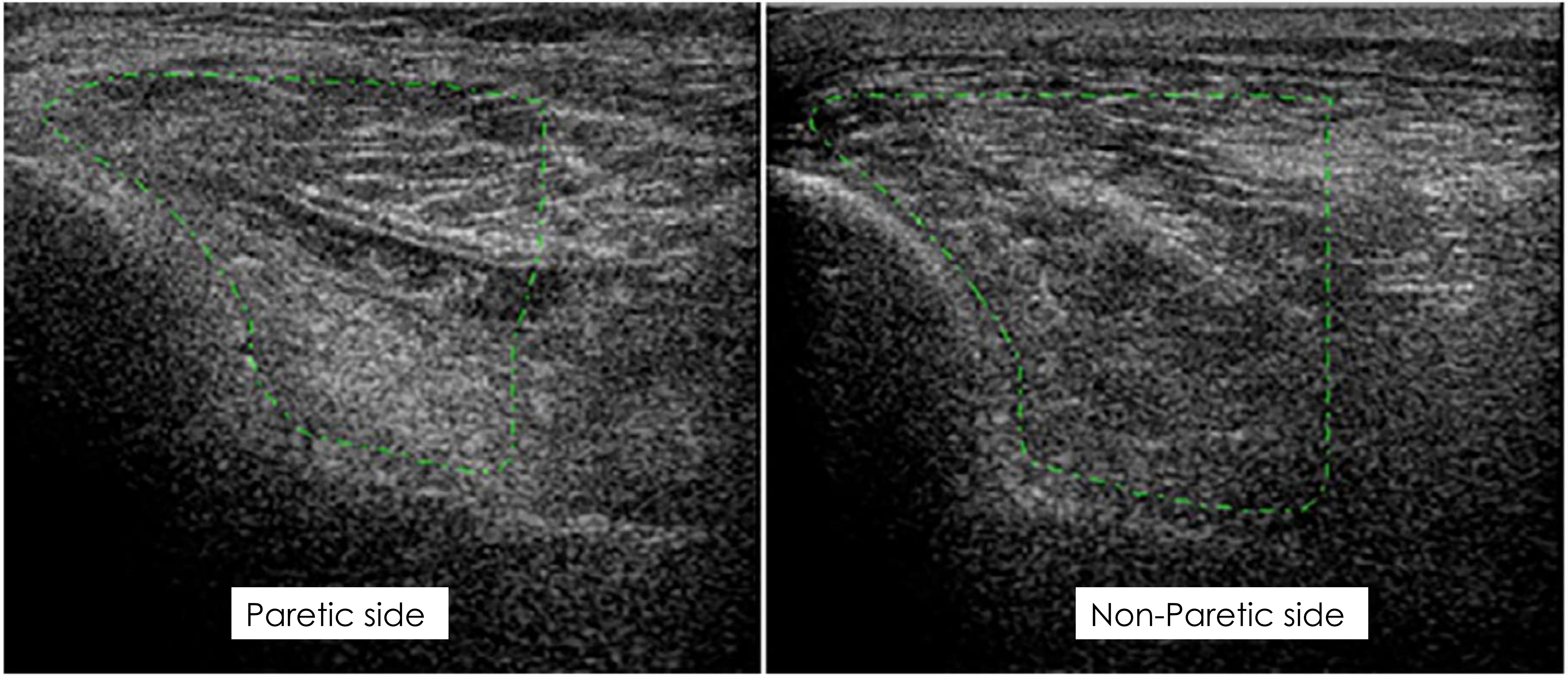


Fig 1. Typical ultrasound images of the paretic lower extremity.

F. Berenpas et al./Clinical Neurophysiology 128 (2017) 115–122



Echogenicity

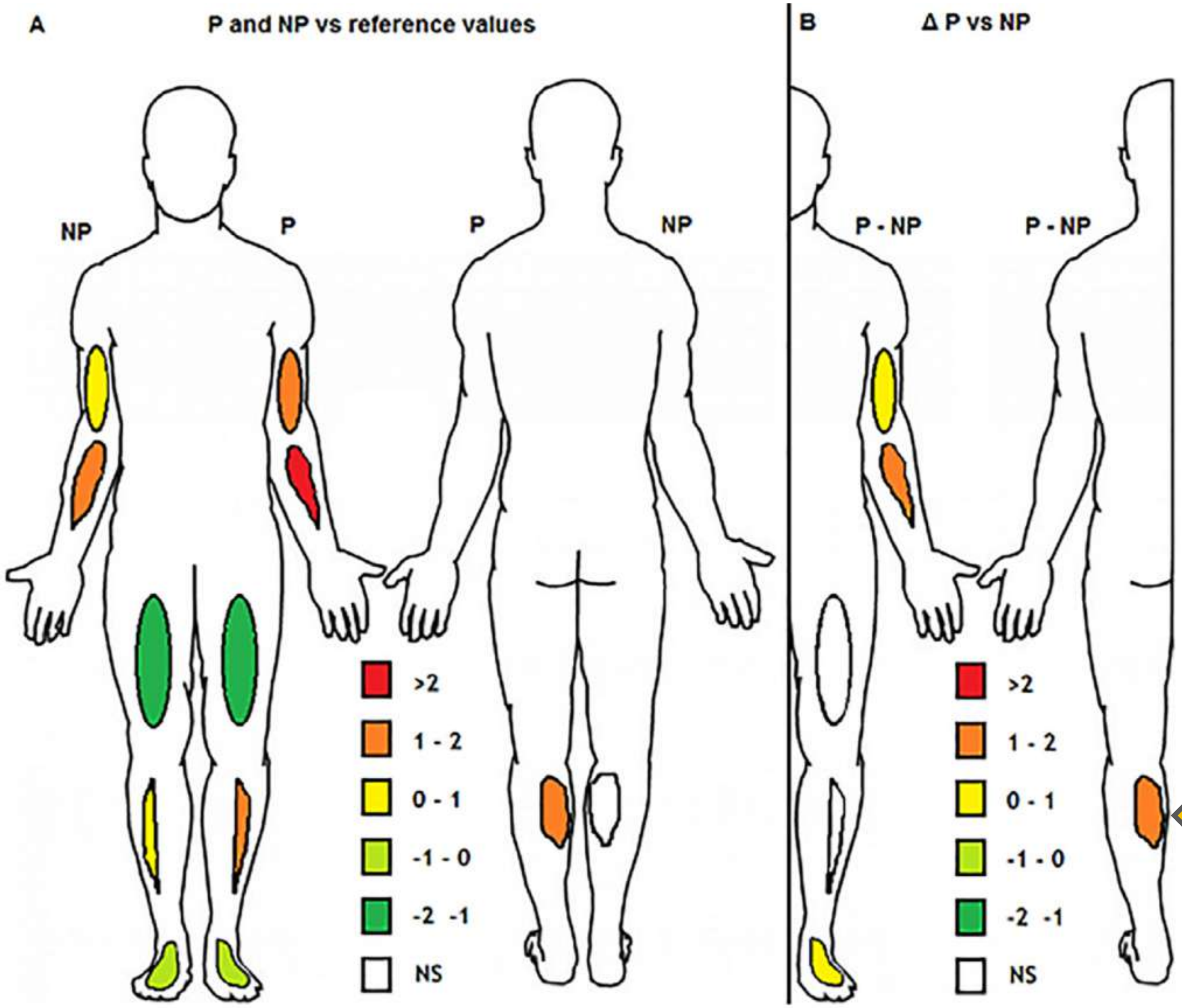


Fig. 2. Mean echogenicity of 6 muscles expressed in *z*-scores. NP = Non-paretic side, P = Paretic side, NS = Not significantly different. Left panel: Colored muscles are significantly different from reference values. Right panel: Colored muscles are significantly different between paretic and non-paretic side. Note: positive *z*-scores indicate reduced muscle quality.

Gait speed (inversely)
Time since stroke

F. Berenpas et al. / Clinical Neurophysiology 128 (2017) 115–122

Thickness

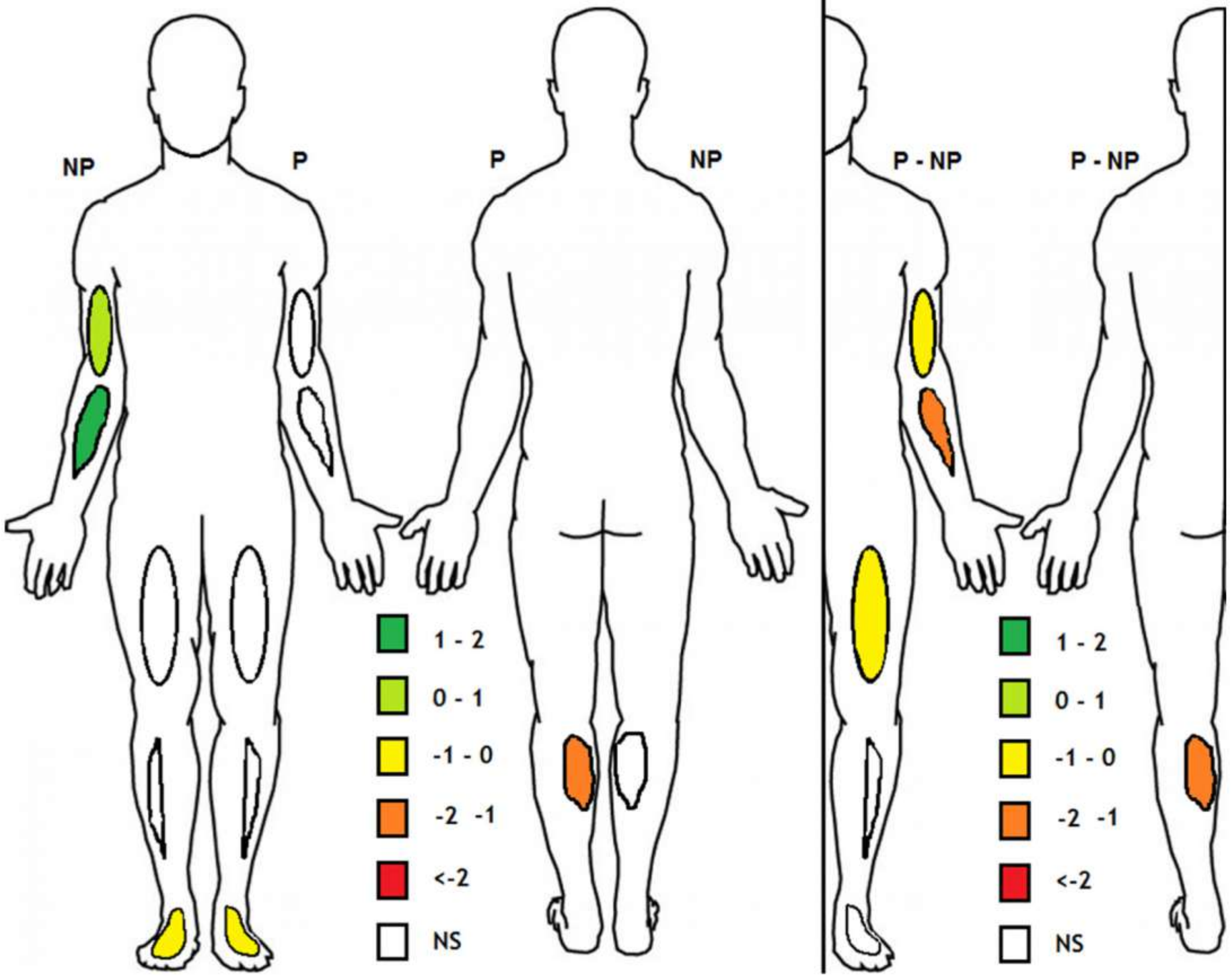


Fig. 3. Mean muscle thickness of 6 muscles expressed in *z*-scores. NP = Non-paretic side, P = Paretic side, NS = Not significantly different. Left panel: Colored muscles are significantly different from reference values. Right panel: Colored muscles are significantly different between paretic and non-paretic side. Note: negative *z*-scores indicate muscle atrophy.

F. Berenpas et al./Clinical Neurophysiology 128 (2017) 115–122

Call to action

Poststroke chronic disease management: towards improved identification and interventions for poststroke spasticity-related complications

Michael Brainin[1*], Bo Norrving[2], Katharina S. Sunnerhagen[3], Larry B. Goldstein[4], Steven C. Cramer[5], Geoffrey A. Donnan[6], Pamela W. Duncan[7], Gerard Francisco[8], David Good[9], Glenn Graham[10], Brett M. Kissela[11], John Olver[12], Anthony Ward[13], Jörg Wissel[14], and Richard Zorowitz[15], on behalf of International PSS Disability Study Group

This paper … is based on the recognised **need for long-term care following stroke**, especially in view of the global increase of disability due to stroke. ….. It is proposed that the aftermath of stroke be considered a chronic disease requiring a multifactorial and multilevel approach.

International Journal of Stroke © 2011 World Stroke Organization Vol 6, February 2011,

Aging after stroke: how to define post-stroke sarcopenia and what are its risk factors?

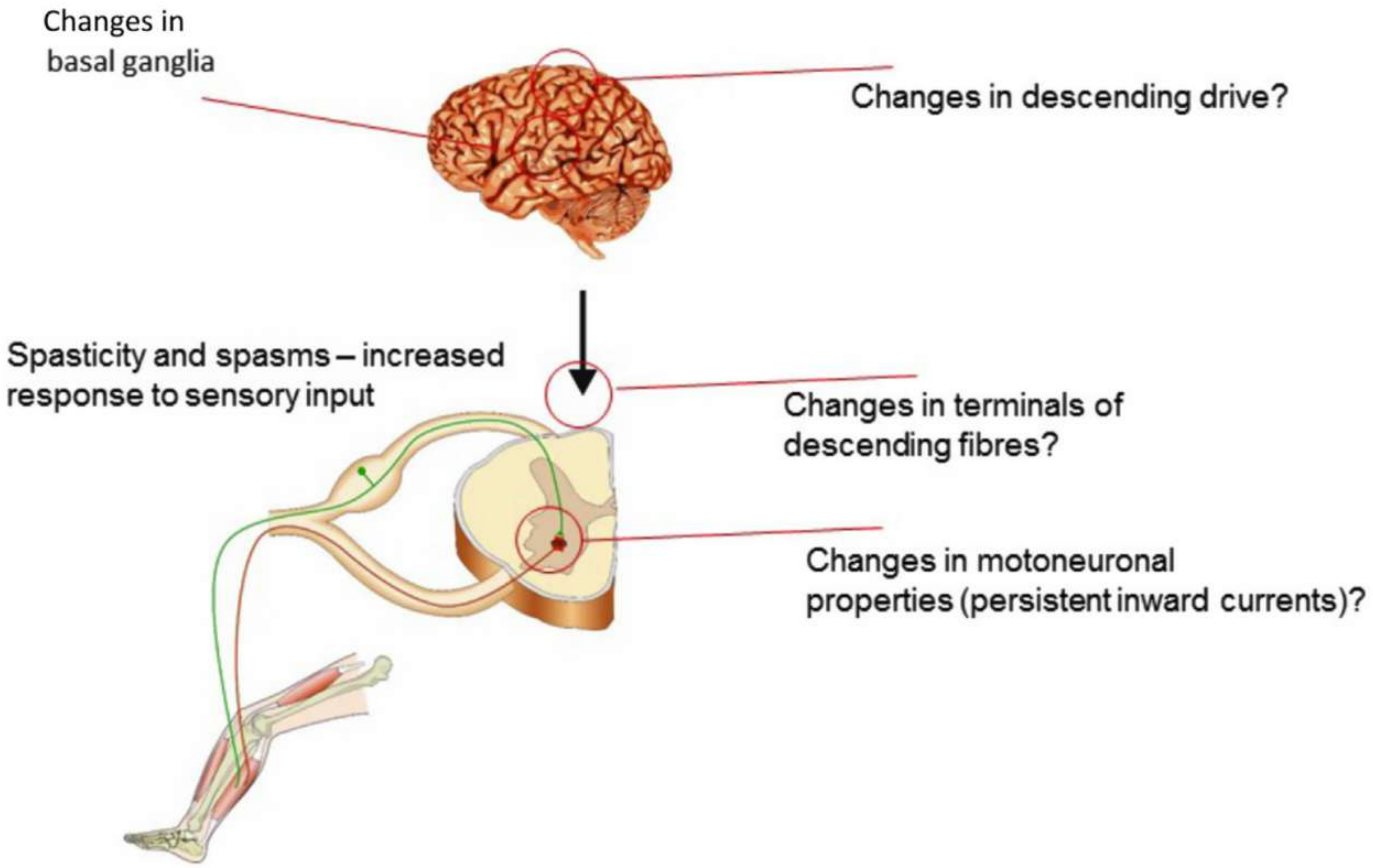
Sheng LI, Javier GONZALEZ-BUONOMO, Jaskiran GHUMAN, Xinran HUANG, Aila MALIK, Nuray YOZBATIRAN, Elaine MAGAT, Gerard E FRANCISCO, Hulin WU, Walter FRONTERA

European Journal of Physical and Rehabilitation Medicine 2022 Sep 05
DOI: 10.23736/S1973-9087.22.07514-1

- Spasticity had a protective role for muscle loss in the affected lower limb, and walking had a protective role for bone loss in the lower limb.

- Clinicians also need to understand potential protective roles of some factors, such as spasticity and walking for the muscles in the lower limb.

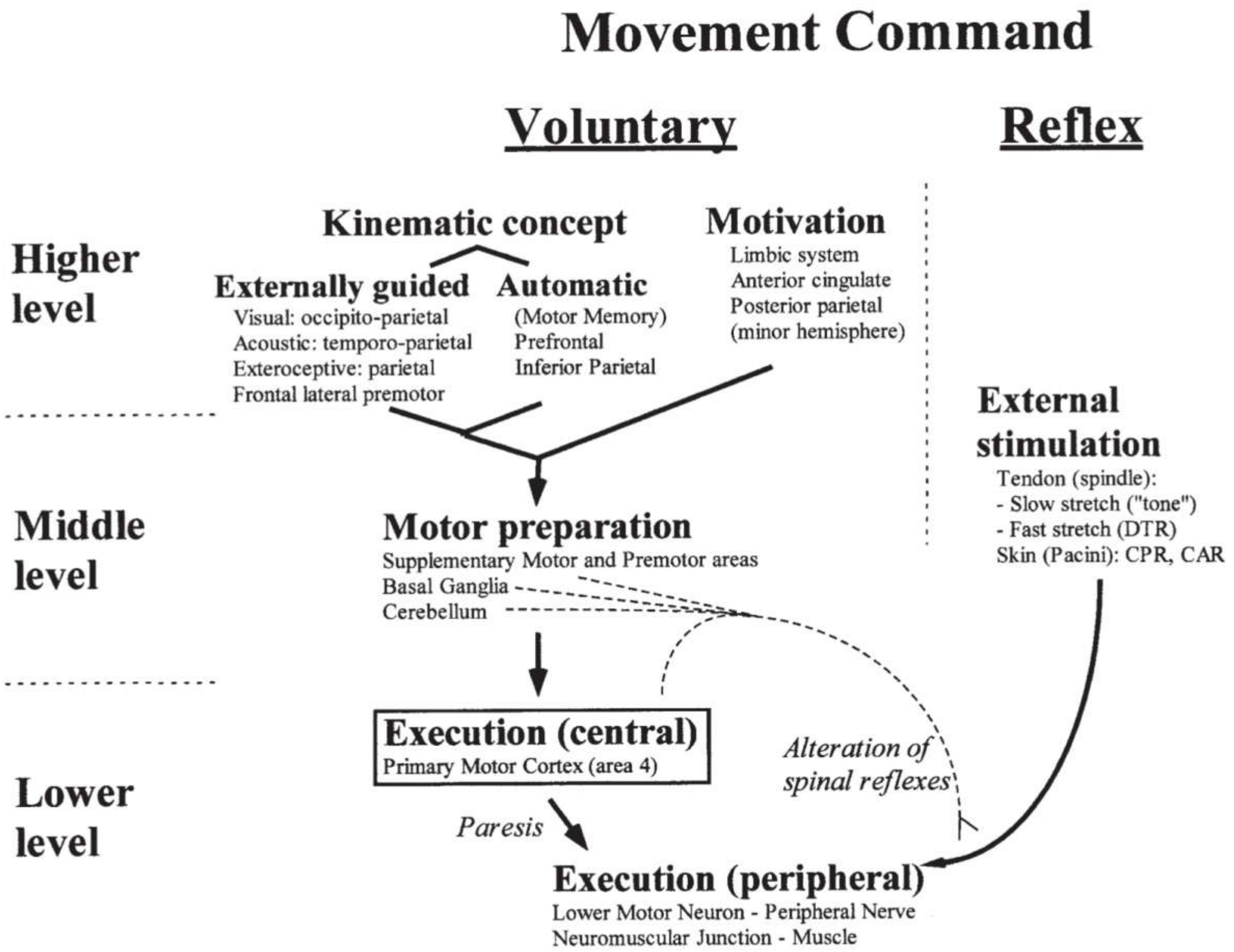
J. Lorentzen et al. / Clinical Neurophysiology 129 (2018) 89–94



Main features of spastic paresis, with their deforming and disabling properties and their clinical measurability. FRA, flexor reflex afferents.

	Symptom name	Condition of detection	Trigger	Deforming capacity	Disabling level	Measurability at bed side
Muscle disorder	Spastic Myopathy	Rest	N/A	High	High	Estimation possible
Neurological disorder						
Paresis	Stretch-sensitive paresis	Effort	N/A	None	Moderate	No
Muscle overactivity types	Spasticity	Rest	Phasic stretch	None	Low	Yes
	Spastic Dystonia	Rest	None	High	High	No
	Spastic Cocontraction	Effort	Effort directed to agonist	None	High	No
	Extrasegmental cocontraction (synkinesis)	Effort	Effort	Moderate	Moderate	No
	Nociceptive (FRA) spasms	Rest or effort	FRA stimulation	Moderate	High	No

M. Baude et al./Annals of Physical and Rehabilitation Medicine 62 (2019) 426–430

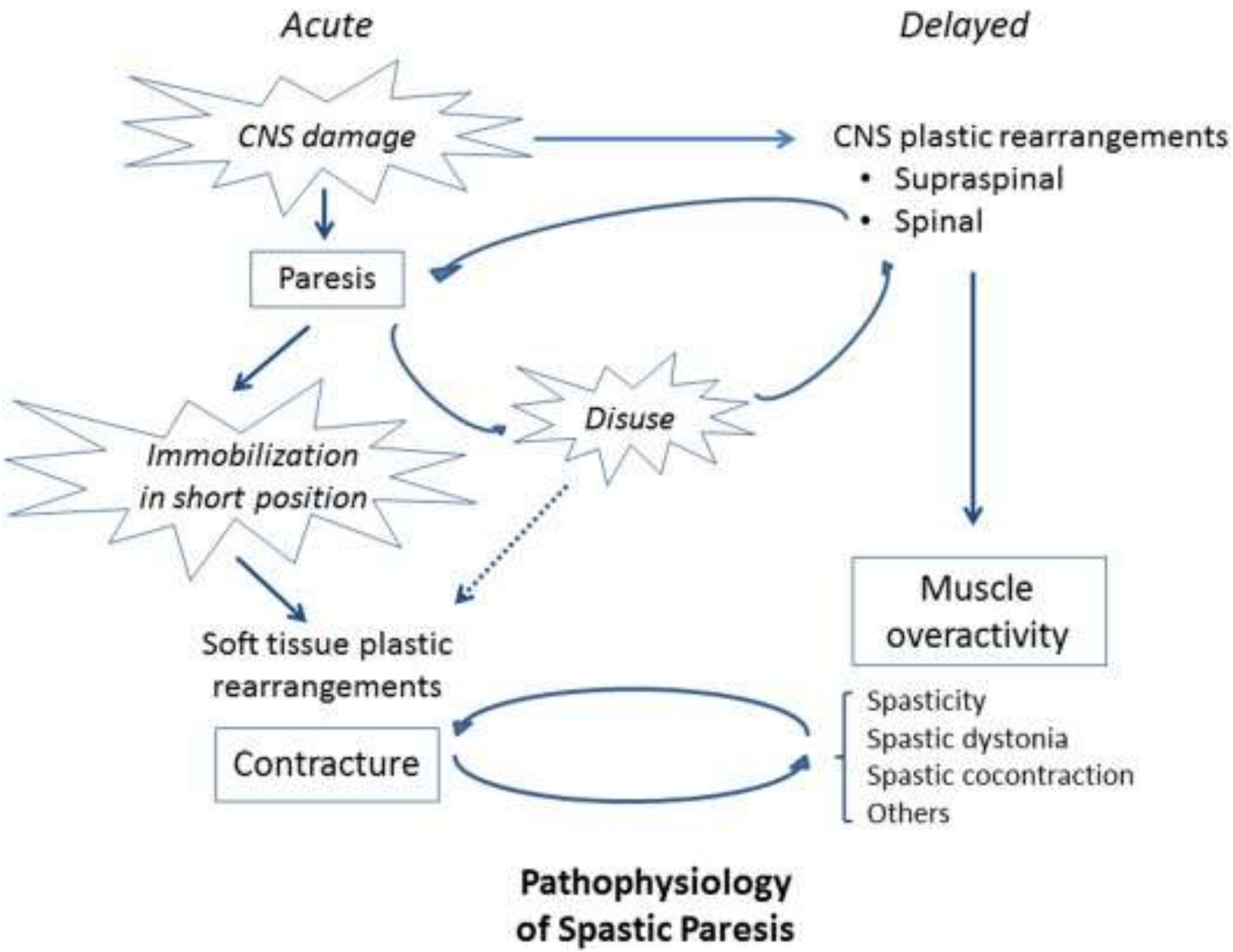


Muscle Nerve **31:** 535–551, 2005

Muscle Nerve **31:** 535–551, 2005

PATHOPHYSIOLOGY OF SPASTIC PARESIS. I: PARESIS AND SOFT TISSUE CHANGES

JEAN-MICHEL GRACIES, MD, PhD



Wissel J. PM&R, Volume 7, Issue 1, 2015, 60–67

Rectus Femoris Characteristics in Post Stroke Spasticity: Clinical Implications from Ultrasonographic Evaluation

Lucia Cosenza [1,2,3,*], Alessandro Picelli [4], Danila Azzolina [5], Marco Alessandro Minetto [6], Marco Invernizzi [1], Michele Bertoni [7], Andrea Santamato [8] and Alessio Baricich [1,2]

Table 2. Descriptive statistics: unaffected vs. hemiparetic sides.

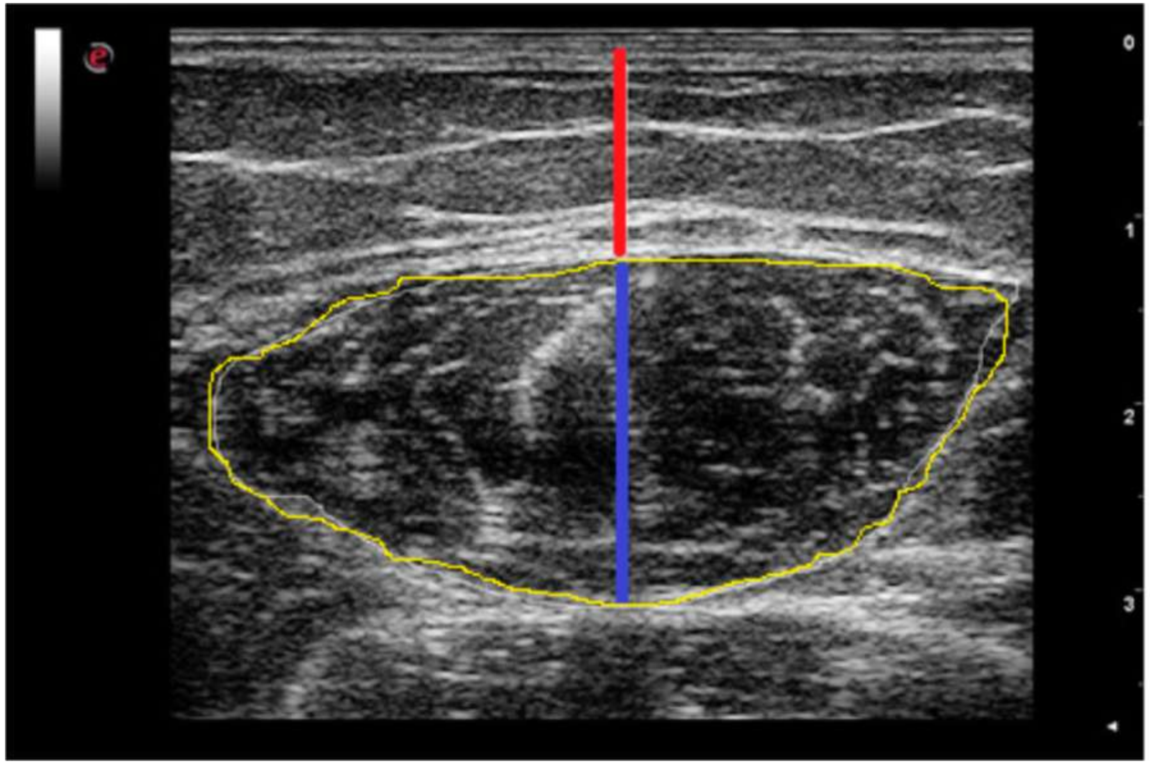
	Hemiparetic Side (N = 47)	Unaffected Side (N = 47)	Test
	25th–75th percentile Median	25th–75th percentile Median	Statistics
MD (cm)	0.76/1.28 1.08	0.69/1.05 0.92	P = 0.09
MT (cm)	1.29/1.84 1.62	1.30/1.78 1.52	P = 0.4
CSA (cm^2)	4.15/6.47 5.41	4.28/6.55 5.33	P = 0.89
MEI	69.8/98.0 85.7	66.5/91.3 80.4	P = 0.46

Abbreviations: MD—muscle depth; MT—muscle thickness; CSA—cross-sectional area; MEI—mean echo intensity.

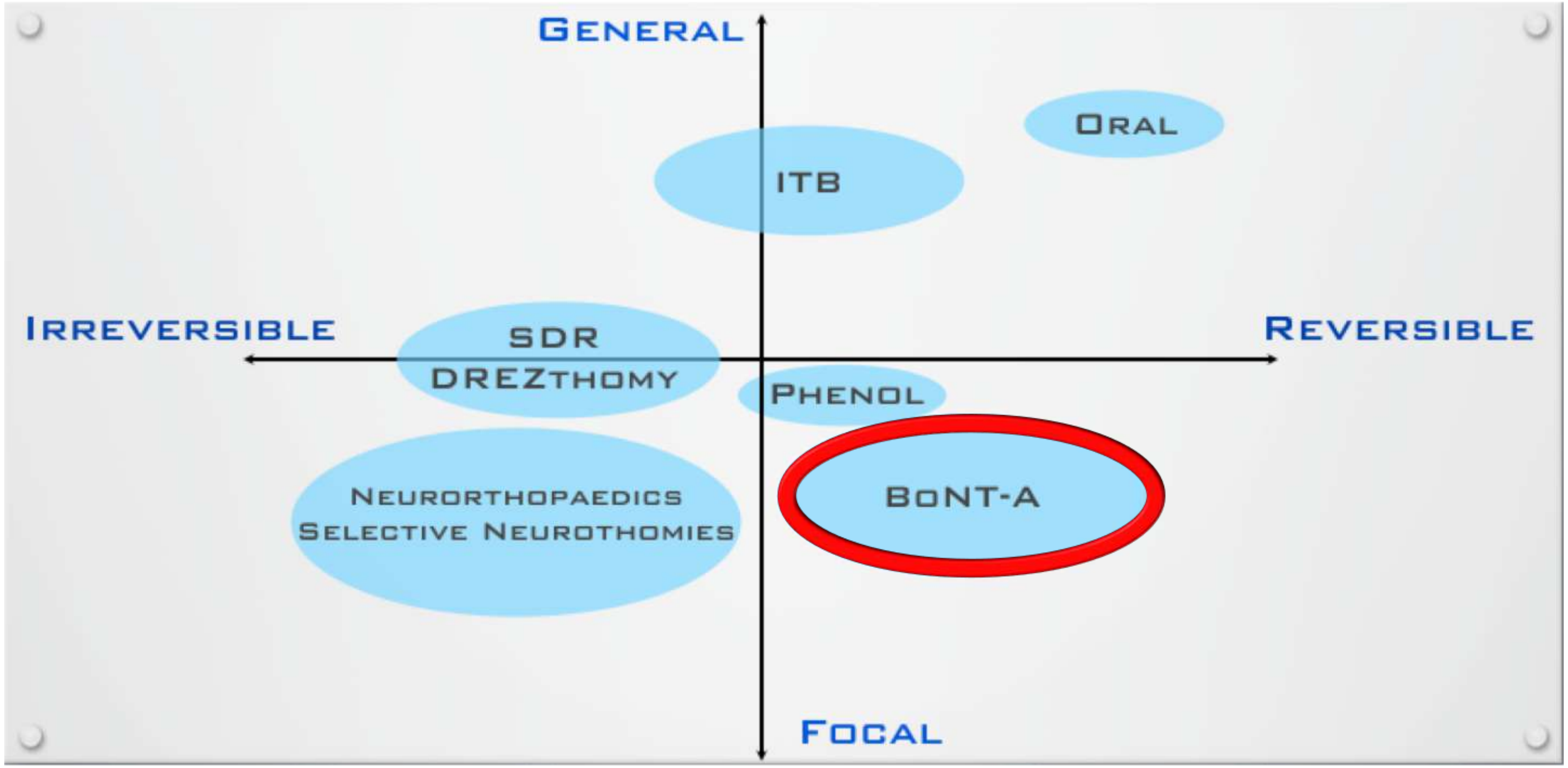
Table 3. Descriptive statistics: treated vs. untreated rectus femoris (RF).

	Hemiparetic Side Treated RF (N = 37)	Hemiparetic Side Untreated RF (N = 10)	Test
	25th–75th percentile Median	25th–75th percentile Median	Statistics
MD (cm)	0.79/1.35 1.11	0.69/1.17 0.97	P = 0.36
MT (cm)	1.34/1.82 1.63	1.18/2.00 1.56	P = 0.6
CSA (cm^2)	4.18/6.37 5.45	3.70/6.46 5.26	P = 0.76
MEI	72.6/97.0 84.5	61.4/115. 4 89.8	P = 0.90

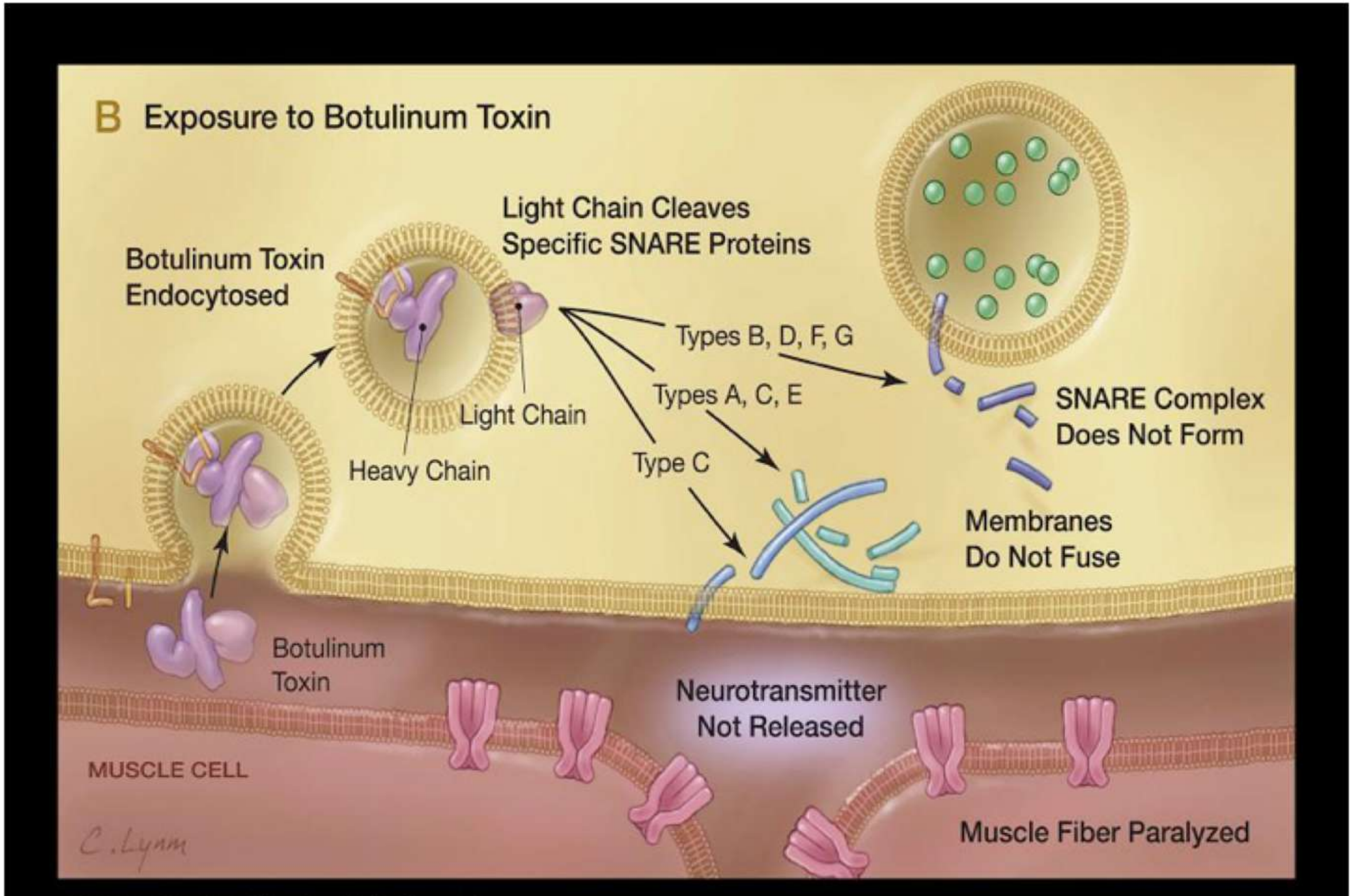
Abbreviations: MD—muscle depth; MT—muscle thickness; CSA—cross-sectional area; MEI—mean echo intensity.



Toxins **2020**, *12*, 490



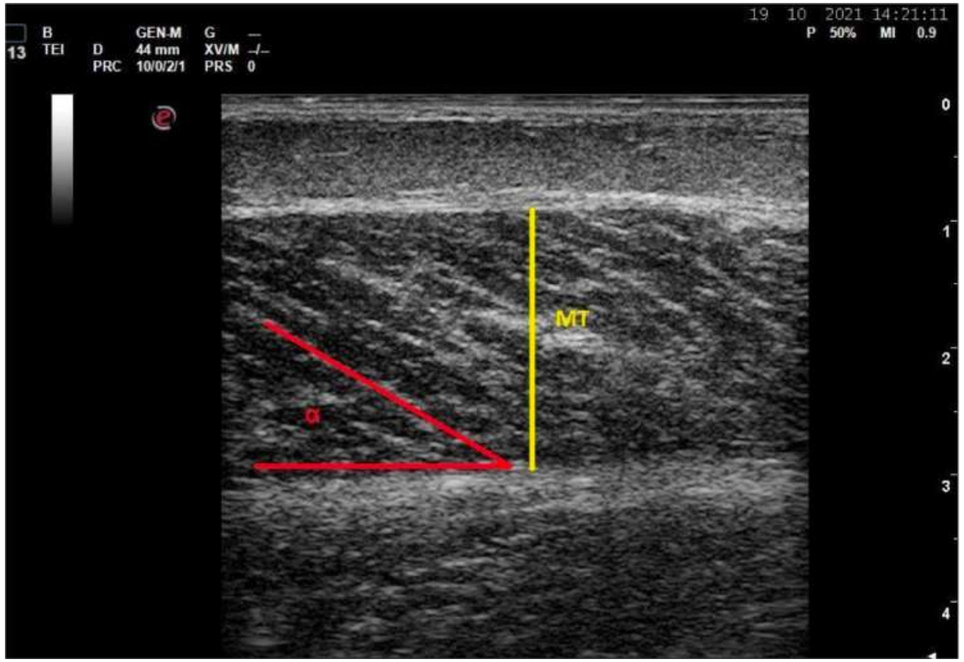
General
Oral
ITB
Irreversible
Reversible
SDR
DREZthomy
Phenol
BoNT-A
Neurorthopaedics
Selective Neurothomies
Focal



JAMA. 2001;285:1061. © American Medical Association

Triceps Surae Muscle Characteristics in Spastic Hemiparetic Stroke Survivors Treated with Botulinum Toxin Type A: Clinical Implications from Ultrasonographic Evaluation

Marco Battaglia [1,2,*], Lucia Cosenza [3], Lorenza Scotti [4], Michele Bertoni [5], Marco Polverelli [3], Alberto Loro [1,2,*], Andrea Santamato [6] and Alessio Baricich [1,2]



Toxins **2021**, *13*, 889. https://doi.org/10.3390/toxins13120889

Stroke and muscle-bone relationship

- Substantial bone changes in the paretic limbs occurred particularly in the **first few months** after stroke onset.
- Early intervention, muscle strength training, and long-term management strategies may be important to enhance bone health post-stroke.

Osteoporosis International (2020) 31:211–224

Non-pharmacological interventions for bone health after stroke

- Statistically significant changes between the intervention and parallel/placebo group in **bone mineral density**, **bone mineral content**, **cortical thickness** and **bone turnover markers** with **specific physical and vibration therapies** ($p<0.05$).
- **Falls** were higher in the intervention group, but no fracture was reported.

PLOS ONE | https://doi.org/10.1371/journal.pone.0263935 February 23, 2022

Biosensors **2022**, *12*, 349. https://doi.org/10.3390/bios12050349

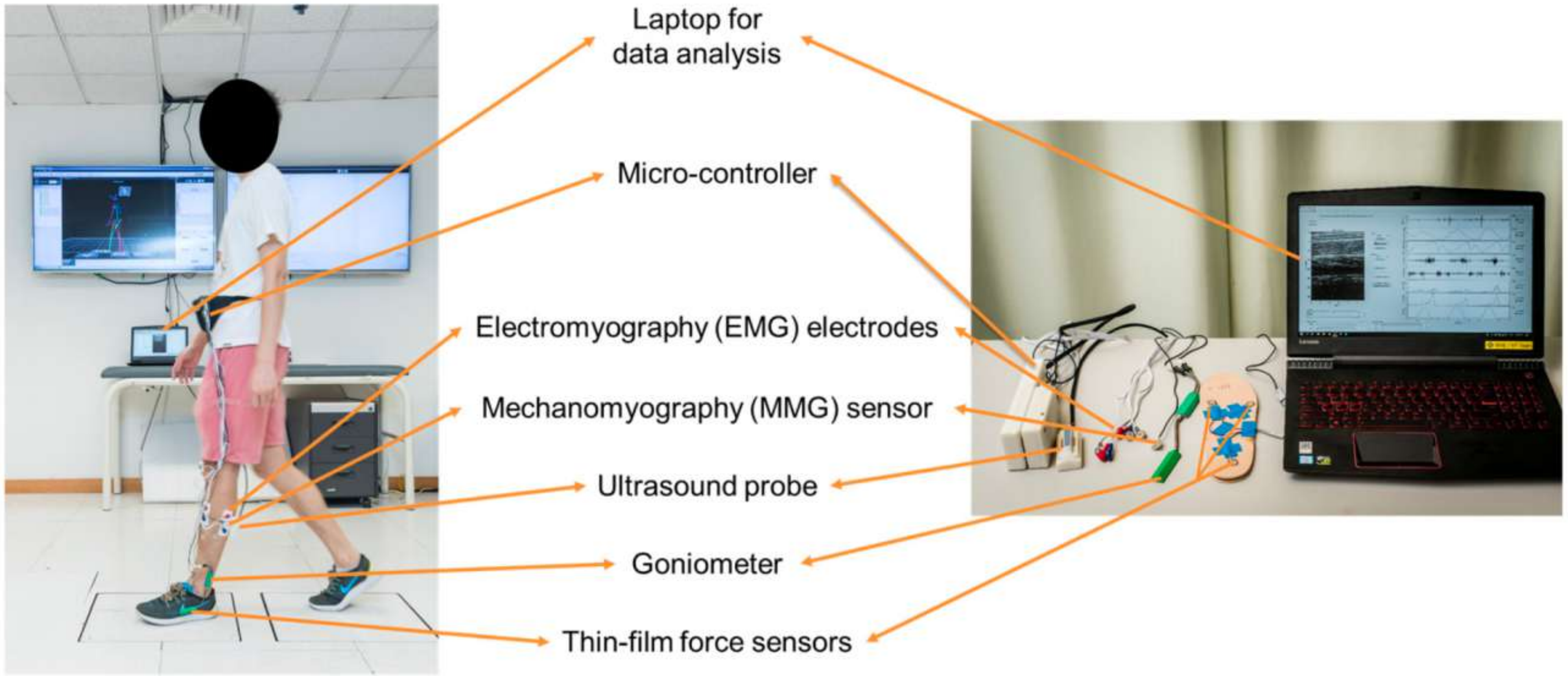
biosensors

MDPI

Brief Report

How Paretic and Non-Paretic Ankle Muscles Contract during Walking in Stroke Survivors: New Insight Using Novel Wearable Ultrasound Imaging and Sensing Technology

Pei-Zhao Lyu [1,†], Ringo Tang-Long Zhu [1,2,†], Yan To Ling [1], Li-Ke Wang [1], Yong-Ping Zheng [1,2] and Christina Zong-Hao Ma [1,2,*]



EUR J PHYS REHABIL MED 2013;49:439-50

The effects of whole-body vibration therapy on bone turnover, muscle strength, motor function, and spasticity in chronic stroke: a randomized controlled trial

M. Y. C. PANG [1], R. W. K. LAU [1], S. P. YIP [2]

Conclusion. **The WBV protocol used in this study did not induce additional effects on bone turnover, knee muscle strength and paretic leg motor function among chronic stroke patients. WBV may have potential to modulate spasticity, but this requires further investigation.**

Scientific Reports | (2021) 11:121 | www.nature.com/scientificreports

scientific reports

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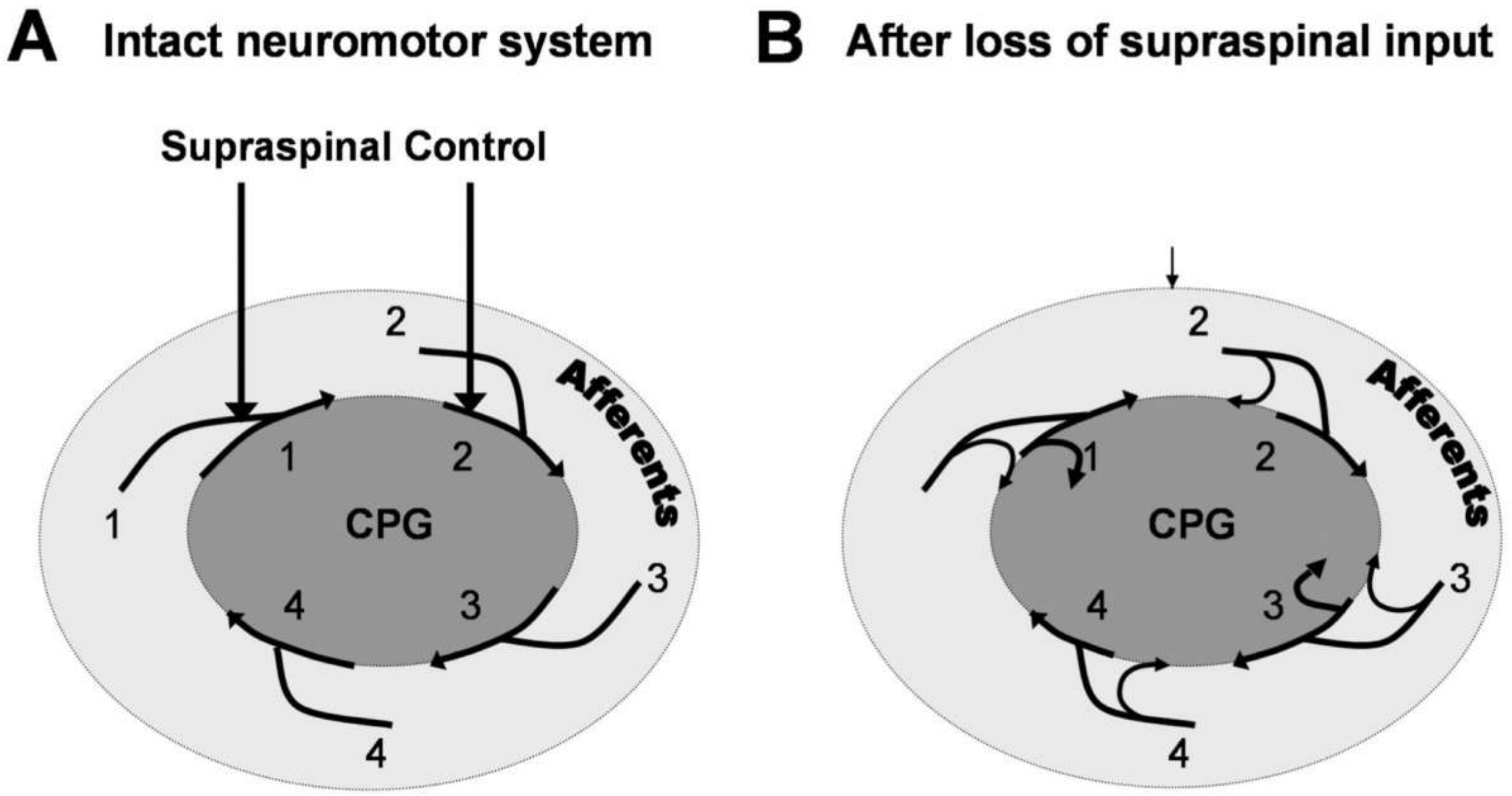
Effects of different vibration frequencies on muscle strength, bone turnover and walking endurance in chronic stroke

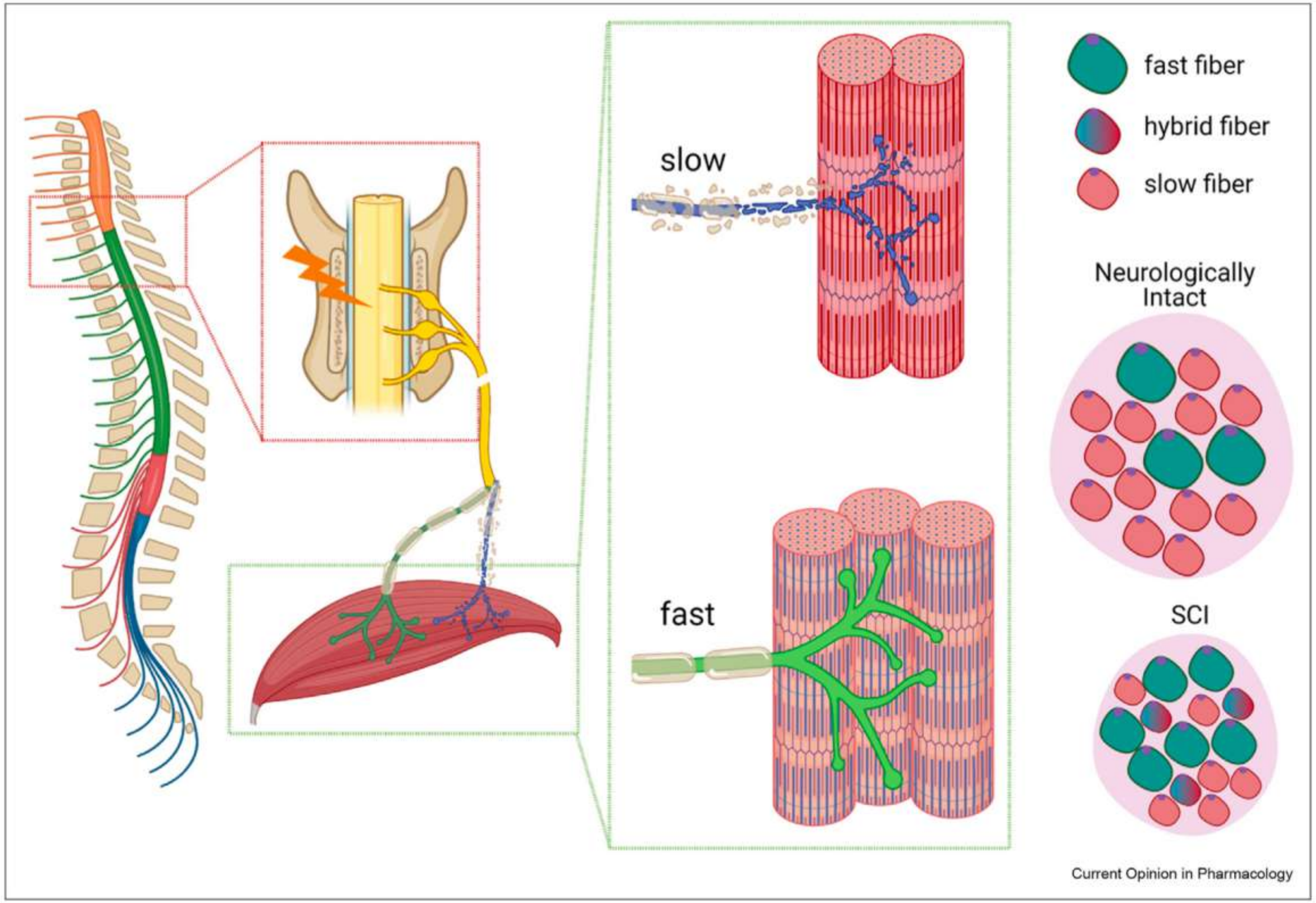
Zhenhui Yang[1,2], Tiev Miller[1], Zou Xiang[3] & Marco Y. C. Pang[1]✉

- Both WBV protocols were effective in improving leg muscle strength and reducing bone resorption.
- Comparatively greater improvement in paretic eccentric leg strength was observed for the 30 Hz protocol

Spinal cord injury



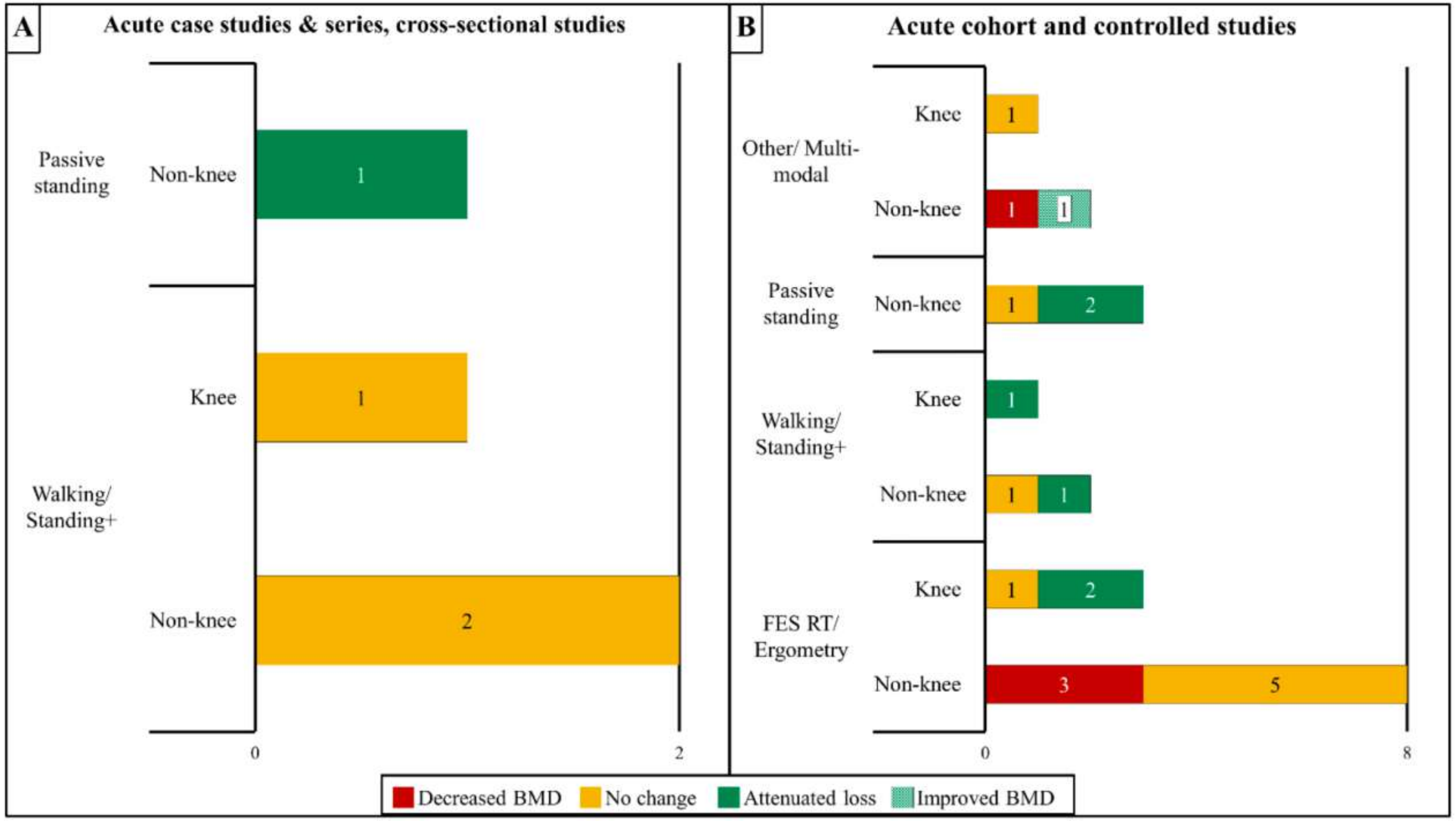
Edgerton et al, Brain Res Rev 2008



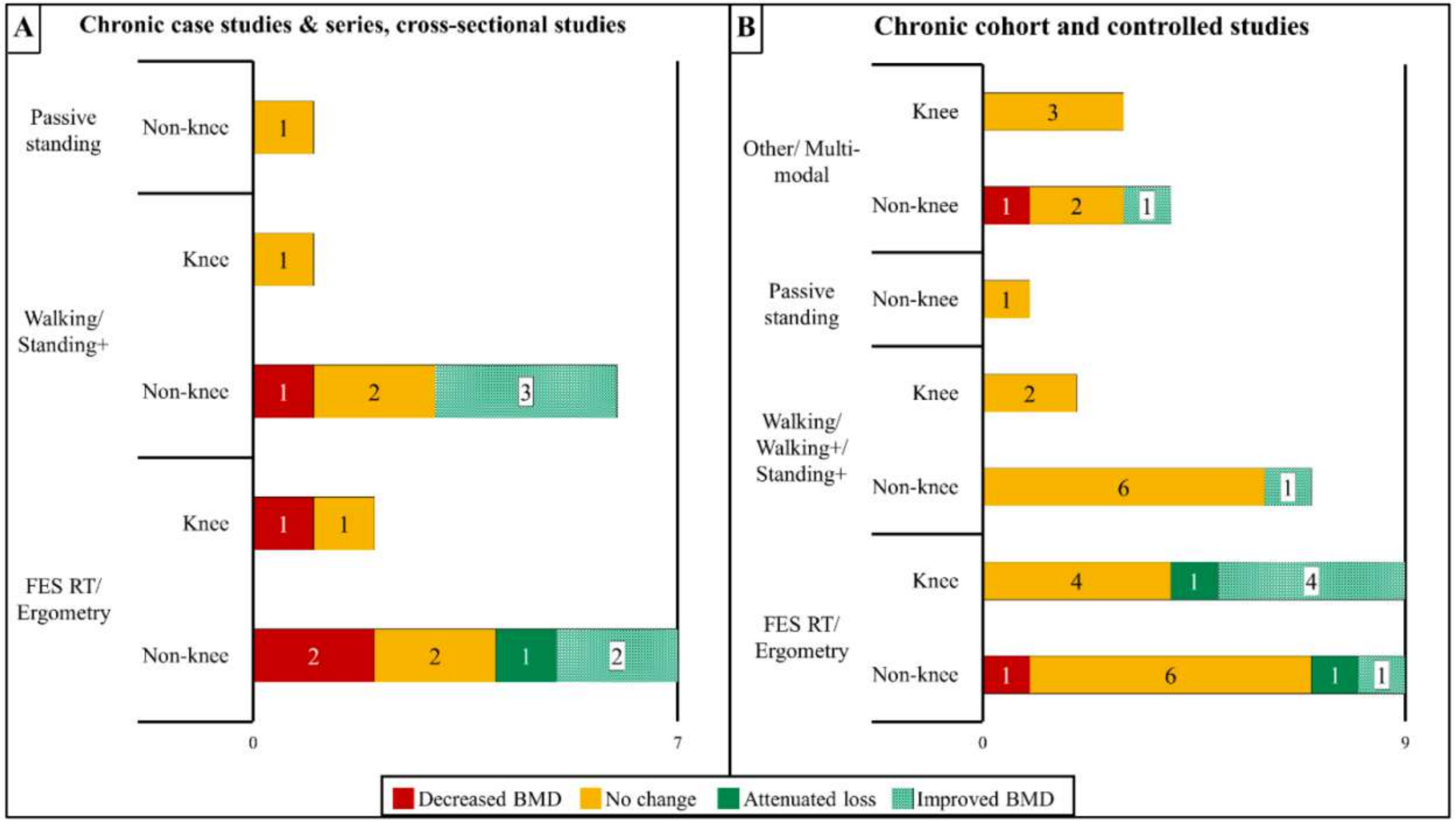
Pathophysiology of skeletal muscle loss after severe spinal cord injury (SCI). SCI results in impaired neural drive, motor neuron atrophy, and pathological changes to the neuromuscular junction that combine to produce low muscle force generating capacity and/or paralysis. Collectively, these deficits impact the rapid rate of muscle atrophy and the repeated denervation–reinnervation cycles that influence the slow-oxidative to fast-glycolytic muscle fiber-type transition in paralyzed muscles. Figure was generated in BioRender.

Int. J. Mol. Sci. **2022**, *23*, 608

Effects of activity-based physical therapy



Effects of activity-based physical therapy



Effects of activity-based physical therapy

- No known ABPT completely prevents bone loss that develops in the lower extremities over the acute/subacute post-SCI period, regardless of the skeletal site that is evaluated.
- No ABPT has shown universal success in increasing BMD at the highly fracture-prone sites surrounding the knee.
- However, a small subset of trials that evaluated FES modalities reported attenuated BMD loss at the distal femur and/or proximal tibia in persons with acute to subacute SCI and increased BMD in those with chronic SCI

Int. J. Mol. Sci. **2022**, *23*, 608

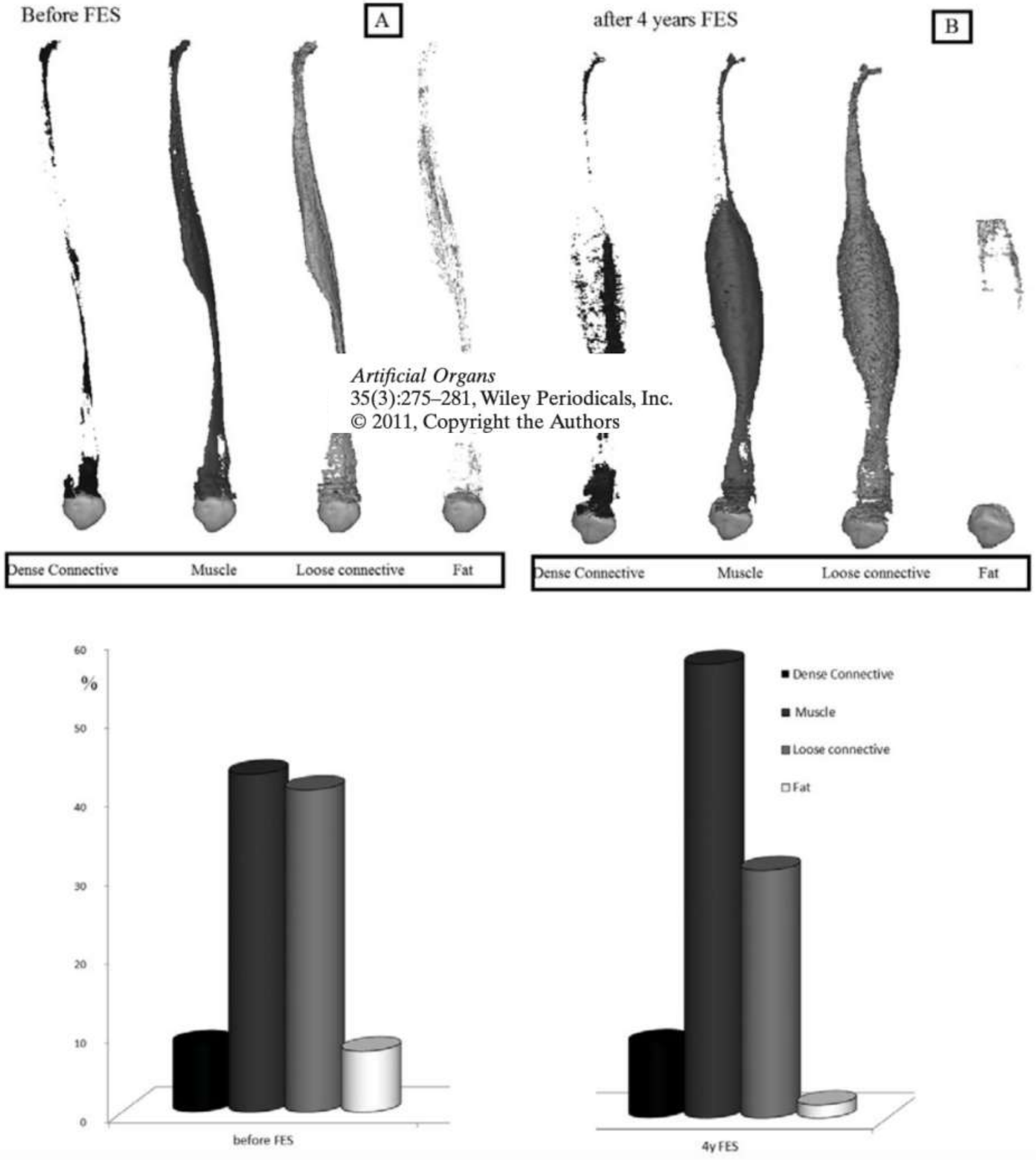
Effects of activity-based physical therapy

- Need to target ABPTs to the specific region(s) where BMD improvements are most warranted
- Need to use a training intensity, frequency, and duration that is sufficient to improve BMD
- Higher total work output was associated with greater BMD gait

Int. J. Mol. Sci. **2022**, *23*, 608

Monitoring of Muscle and Bone Recovery in Spinal Cord Injury Patients Treated With Electrical Stimulation Using Three-Dimensional Imaging and Segmentation Techniques: Methodological Assessment

*†Paolo Gargiulo, *†Thordur Helgason, *†‡Páll Jens Reynisson, §Benedikt Helgason, ¶Helmut Kern, **Winfried Mayr, ††Páll Ingvarsson, and ‡‡Ugo Carraro



Artificial Organs
35(3):275–281, Wiley Periodicals, Inc.

FIG. 4. 3-D appearance and histogram showing distribution of fat, loose connective, muscle fibers, and dense connective in LMN patient after 4 (A) and 8 years (B) postinjury during which the muscles were stimulated with FES (Patient 2).

Artificial Organs
35(3):275–281, Wiley Periodicals, Inc.
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Monitoring of Muscle and Bone Recovery in Spinal Cord Injury Patients Treated With Electrical Stimulation Using Three-Dimensional Imaging and Segmentation Techniques: Methodological Assessment

*†Paolo Gargiulo, *†Thordur Helgason, *†‡Páll Jens Reynisson, §Benedikt Helgason, ¶Helmut Kern, **Winfried Mayr, ††Páll Ingvarsson, and ‡‡Ugo Carraro

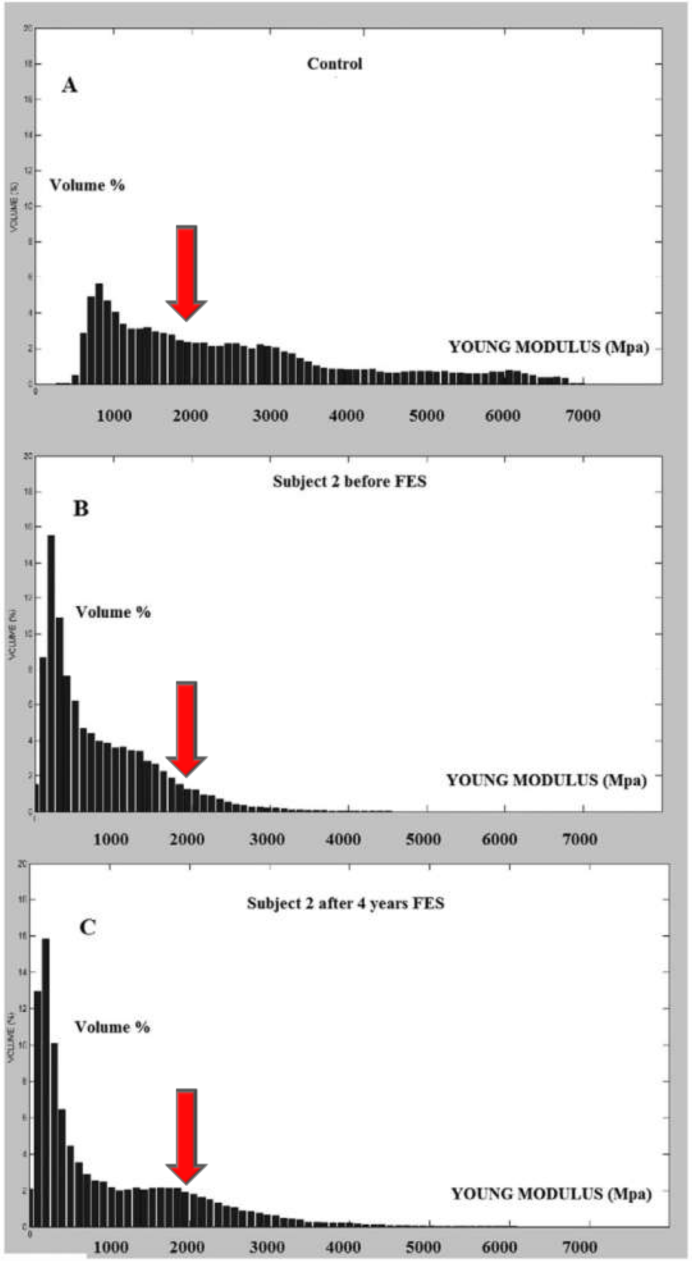


FIG. 5. Young's modulus distribution (MPa) in the left patellar bone for: control (A), subject 2 before FES treatment (B), and subject 2 after 4 years of FES treatment (C). The Young's modulus value is measured in Mega Pascal (MPa), display values between (0, 7000), on the *x*-axis (MPa), and the volume as percentage (%) on the *y*-axis.

Artificial Organs
35(3):275–281, Wiley Periodicals, Inc.

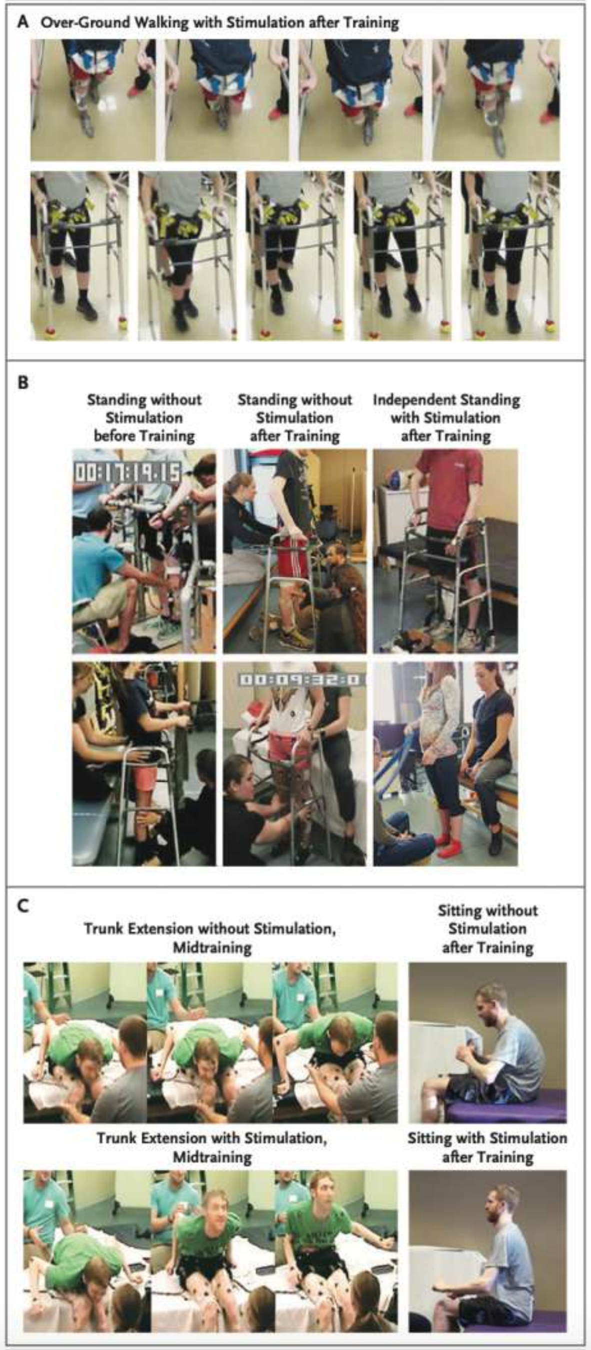
The NEW ENGLAND JOURNAL of MEDICINE

BRIEF REPORT

Recovery of Over-Ground Walking after Chronic Motor Complete Spinal Cord Injury

Claudia A. Angeli, Ph.D., Maxwell Boakye, M.D., Rebekah A. Morton, B.S., Justin Vogt, B.S., Kristin Benton, B.S., Yangshen Chen, Ph.D., Christie K. Ferreira, B.S., and Susan J. Harkema, Ph.D.

N ENGL J MED 379;13 NEJM.ORG SEPTEMBER 27, 2018




WOODWAY
WOODWAY


STAIRWALKER

Robotic Walking to Mitigate Bone Mineral Density Decline and Adverse Body Composition in Individuals With Incomplete Spinal Cord Injury

A Pilot Randomized Clinical Trial

Claire Shackleton, PhD, Robert Evans, PhD, Sacha West, PhD, Wayne Derman, MD, PhD, and Yumna Albertus, PhD

TABLE 2. A summary of BMD and body composition characteristics between the RLT and ABT groups

	RLT (n = 8)				ABT (n = 8)				Between Group	
DXA Outcomes	**Pre**	**Post**	**Δ (95% CI)**	**ES**	**Pre**	**Post**	**Δ (95% CI)**	**ES**	***P***	**ES**
Bone mineral density (g/cm^2)										
Spinal BMD	0.97 ± 0.09	0.97 ± 0.10	0.00 (−0.09 to 0.09)	0.09	0.98 ± 0.13	0.98 ± 0.15	0.00 (−0.14 to 0.14)	0.09	0.96	0.03
Hip BMD	1.25 ± 0.07	1.24 ± 0.08	0.01 (−0.08 to 0.06)	0.31	1.23 ± 0.27	1.20 ± 0.25	0.03 (−0.29 to 0.23)[a]	0.43	0.13	0.12
Femoral neck BMD	1.15 ± 0.14	1.13 ± 0.14	0.02 (−0.16 to 0.12)	0.31	1.21 ± 0.30	1.15 ± 0.27	0.06 (−0.34 to 0.22)[a]	**0.86**	0.16	0.09
Fat mass										
Whole-body FM, kg	18.53 ± 9.18	18.29 ± 8.32	0.24 (−8.83 to 8.34)	0.17	25.93 ± 10.60	23.46 ± 9.57	2.47 (−12.37 to 7.43)	0.42	0.38	0.35
Appendicular FM, kg	7.86 ± 3.20	7.85 ± 3.03	0.010 (−3.06 to 3.04)	0.07	12.15 ± 4.28	11.03 ± 3.11	1.12 (−4.79 to 2.55)	0.47	0.44	0.46
Trunk FM, kg	10.67 ± 6.19	10.37 ± 5.60	0.30 (−6.79 to 6.19)	0.32	13.78 ± 6.91	12.43 ± 6.74	1.35 (−8.04 to 5.34)	0.52	0.28	0.25
Whole-body fat, % FM	28.62 ± 10.36	28.18 ± 9.56	0.44 (−10.25 to 11.3)	0.22	34.79 ± 7.13	32.47 ± 5.33	2.32 (−4.43 to 9.07)	0.67	0.40	0.20
Appendicular fat, % FM	44.56 ± 6.35	44.76 ± 6.90	0.20 (−6.29 to 6.69)	0.10	49.04 ± 9.20	49.97 ± 9.69	0.93 (−8.33 to 10.19)	0.40	0.57	0.24
Trunk fat, % FM	55.44 ± 6.35	55.24 ± 6.90	0.20 (−6.69 to 6.29)	0.10	50.96 ± 9.20	50.03 ± 9.69	0.93 (−10.19 to 8.33)	0.40	0.57	0.24
Gynoid FM, kg	2.84 ± 1.13	2.82 ± 1.21	0.20 (−1.17 to 1.13)	0.22	4.16 ± 1.45	3.62 ± 1.03	0.54 (−1.77 to 0.69)[a]	**0.62**	0.28	0.28
Subcutaneous fat, cm^2	172 ± 103	170 ± 100	2 (−101.48 to 97.48)	0.42	244 ± 115	227 ± 108	17 (−126.32 to 92.32)	0.22	0.88	0.30
Visceral fat, cm^2	144 ± 100	142 ± 104	2 (−101.98 to 97.98)	0.12	152 ± 92	129 ± 82	23 (−108.39 to 62.39)[a]	**0.72**	0.08	0.01
Fat-free soft tissue mass (kg)										
Whole-body FFSTM	41.34 ± 3.96	41.94 ± 4.63	0.60 (−3.62 to 4.82)	0.52	43.11 ± 11.45	43.91 ± 12.51	0.80 (−10.95 to 12.55)	0.27	0.96	0.04
Appendicular FFSTM	17.96 ± 2.26	18.30 ± 2.38	0.34 (−1.93 to 2.61)	0.22	19.65 ± 6.32	20.01 ± 6.73	0.36 (−6.04 to 6.76)	0.27	0.88	0.06
Leg FFSTM	12.78 ± 2.03	13.20 ± 2.35	0.42 (−1.73 to 2.57)	0.17	14.50 ± 4.79	14.77 ± 5.16	0.27 (−4.61 to 5.1)	0.32	0.51	0.12
Arm FFSTM	5.10 ± 1.21	5.44 ± 1.24	0.34 (−0.86 to 1.54)[a]	**0.87**	5.24 ± 1.65	5.59 ± 1.75	0.35 (−1.32 to 2.02)[a]	**0.87**	0.96	0.01

Data are presented as mean ± SD and mean difference ± 95% CI. Medium to large effect sizes are indicated in bold.

[a] Statistical significance is accepted at $P < 0.05$.

Pre, week 0 measurement; post, week 24 measurement.

Effect of hybrid FES exercise on body composition during the sub-acute phase of spinal cord injury

Khashayar Afshari[1,2,3], Erin D. Ozturk[2], Brandon Yates[1,2,3], Glen Picard[2], J. Andrew Taylor[1,2,3]*

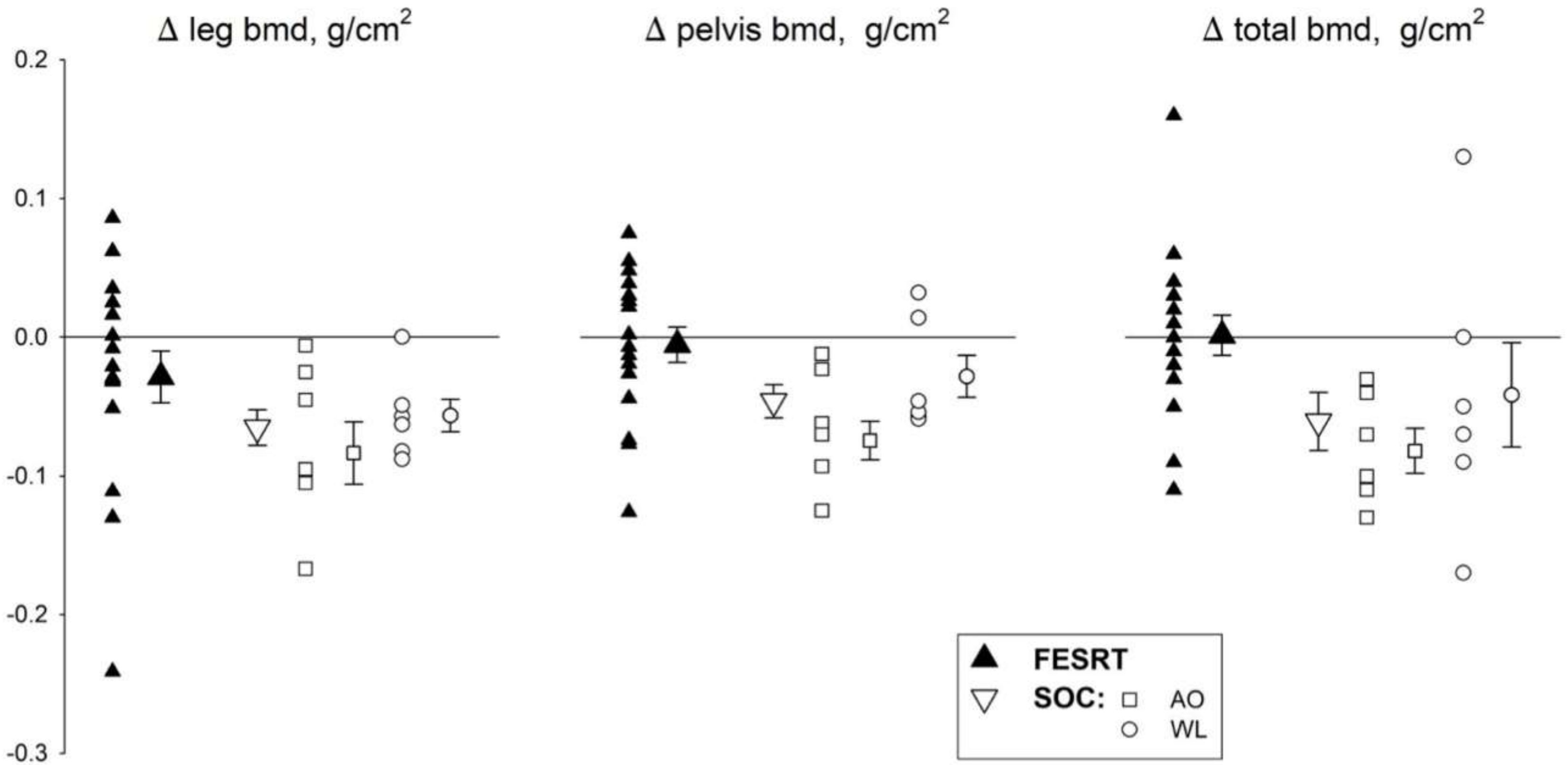


Fig 3. Bone density changes. Individual and group mean legs, pelvis and total bone mineral density compared between FESRT and SOC and subgroups AO and WL. Results of regression analysis indicated significantly lower time dependent decrease in total BMD and pelvis BMD of FESRT group compared to SOC ($p = 0.039$ and $p = 0.028$ respectively). Although the results for legs BMD were not statistically significant, a similar tendency was detected for this variable ($p = 0.14$, R-squared = 0.21).

PLOS ONE | https://doi.org/10.1371/journal.pone.0262864 January 24, 2022

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The effect of Functional Electrical Stimulation-assisted posture-shifting in bone mineral density: case series-pilot study

Monica Armengol[1]✉, Ioannis D. Zoulias[1], Robin S. Gibbons[2], Ian McCarthy[3], Brian J. Andrews[4,5], William S. Harwin[1] and William Holderbaum[1,6]

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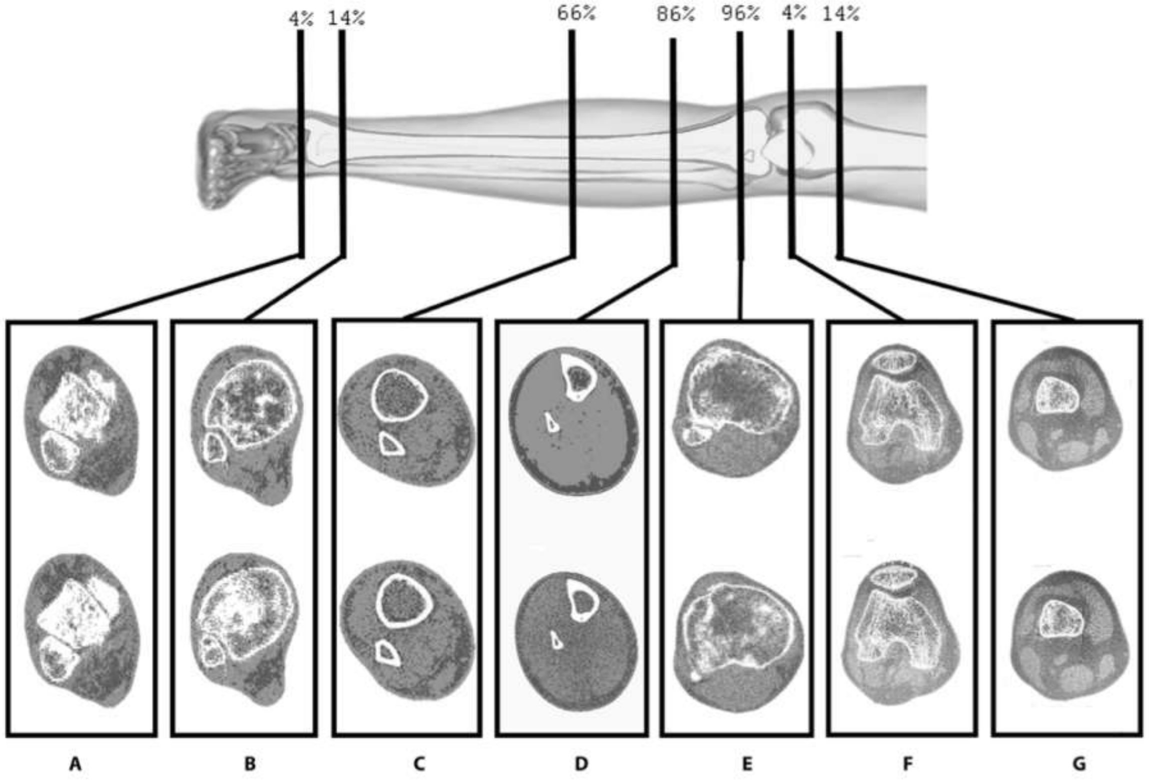
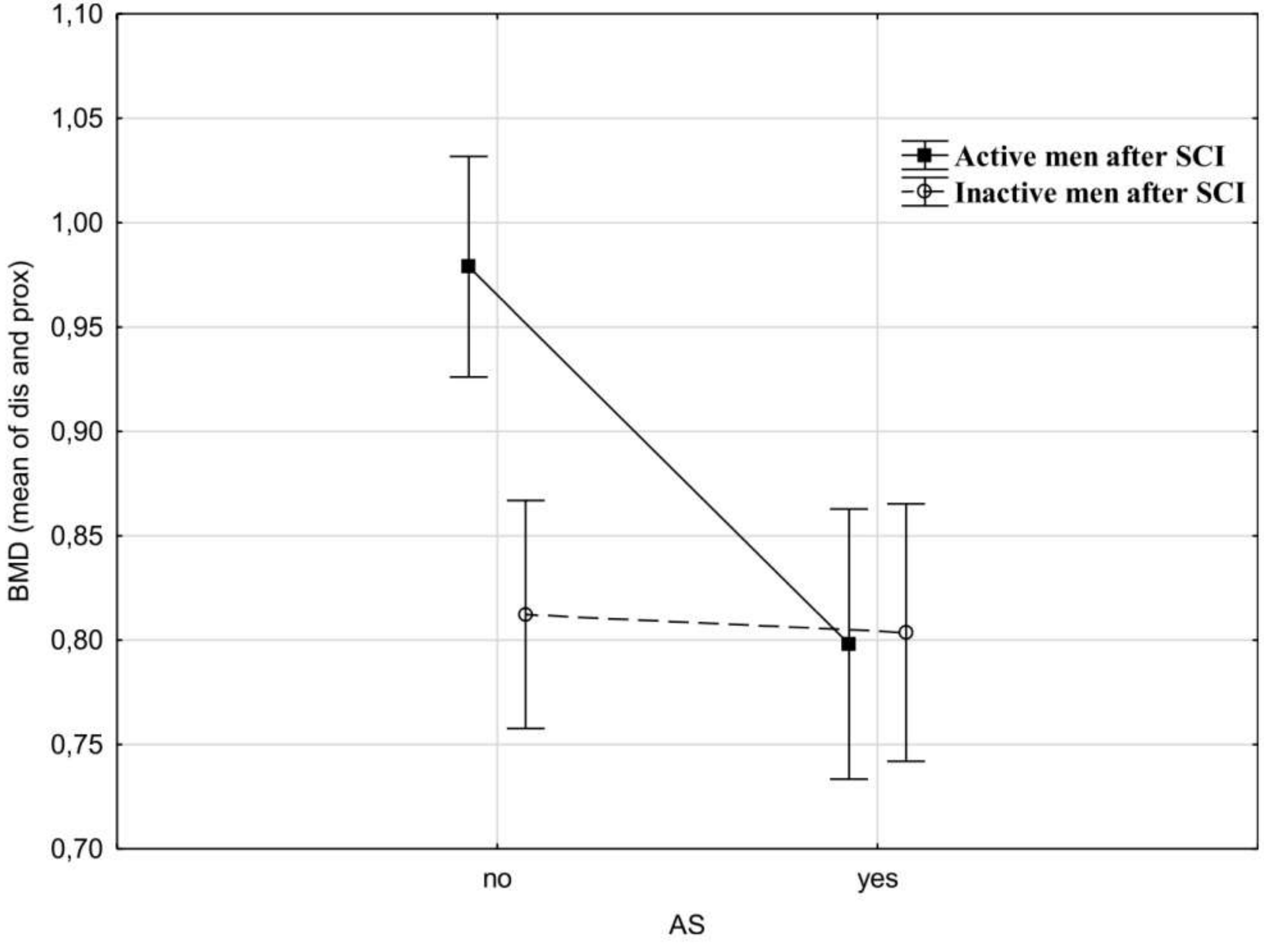


Fig. 7 BMD changes at t1 (first row) to t2 (second row). Images correspond to pQCT sections of the Tibia 4%, 4%, 14%, 86% and 96% for **A**–**E** respectively and Femur 4% and 14% for **F**, **G** respectively. Reference lines for these scans were the malleolus for **A**–**D** and the tibial plateau for **D**–**G**. pQCT images **A**, **C**, **F**, **G** correspond to P1 and **B**, **D**, **E** correspond to P2.

Forearm bone mineral density in adult men after spinal cord injuries: impact of physical activity level, smoking status, body composition, and muscle strength

Anna Kopiczko[1*] and Joanna Cieplińska[2]



Kopiczko and Cieplińska *BMC Musculoskeletal Disorders* (2022) 23:81

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Hylonome

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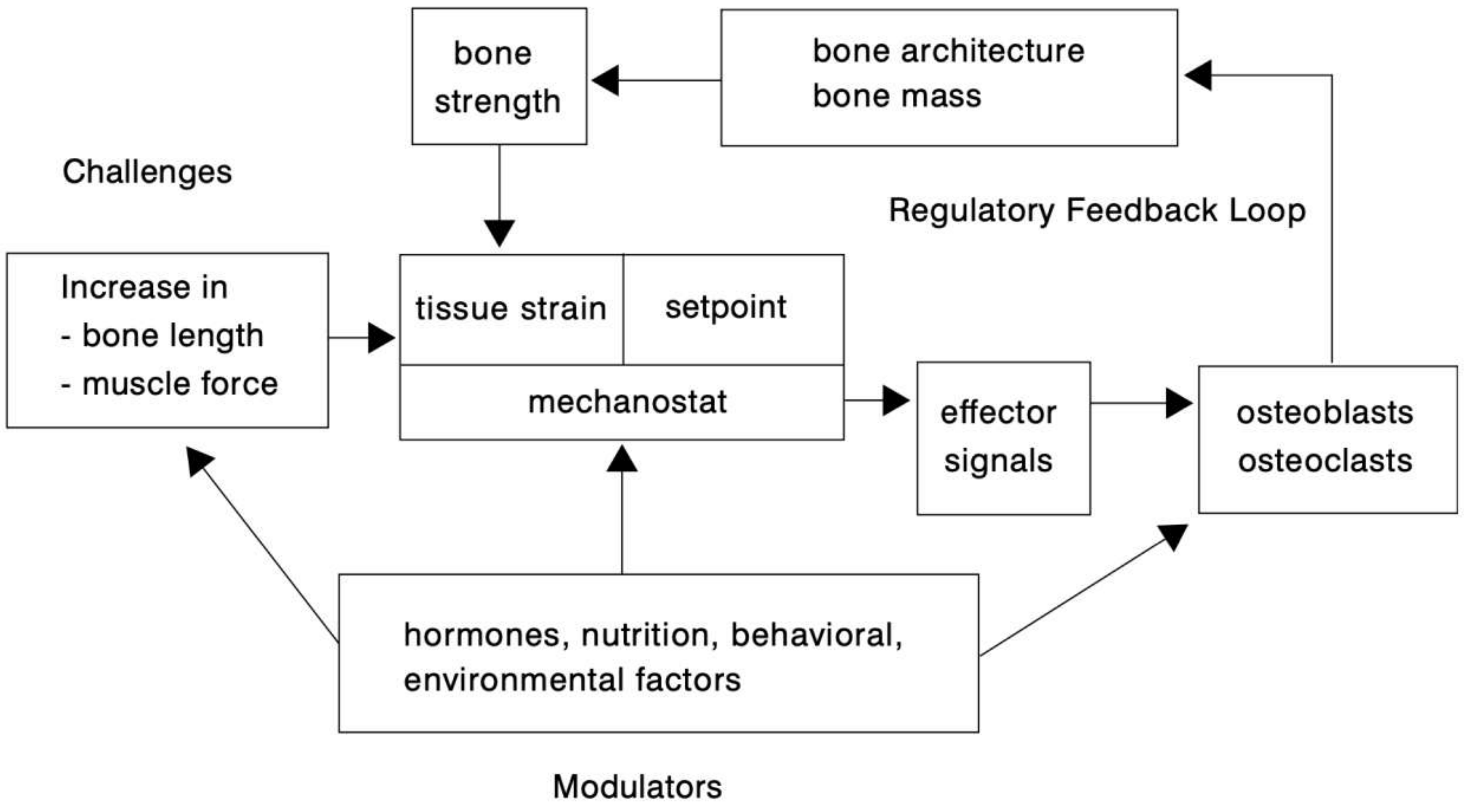
E. Schoenau



Frontiers in Neurology > Neurorehabilitation > Research Topics > Long Term Disability in Neurolo...

Long Term Disability in Neurological Disease: A Rehabilitation Perspective

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Editorial: Long term disability in neurological disease: A rehabilitation perspective

Alessio Baricich[1,2]*, Grazia F. Spitoni[3,4] and Giovanni Morone[5]

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TYPE Editorial
PUBLISHED 17 August 2022
DOI 10.3389/fneur.2022.964664

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