Simposio satellite

La valutazione del paziente con spasticità

21 maggio 2022

Riabilitazione nella spasticità

A. Sant'Angelo

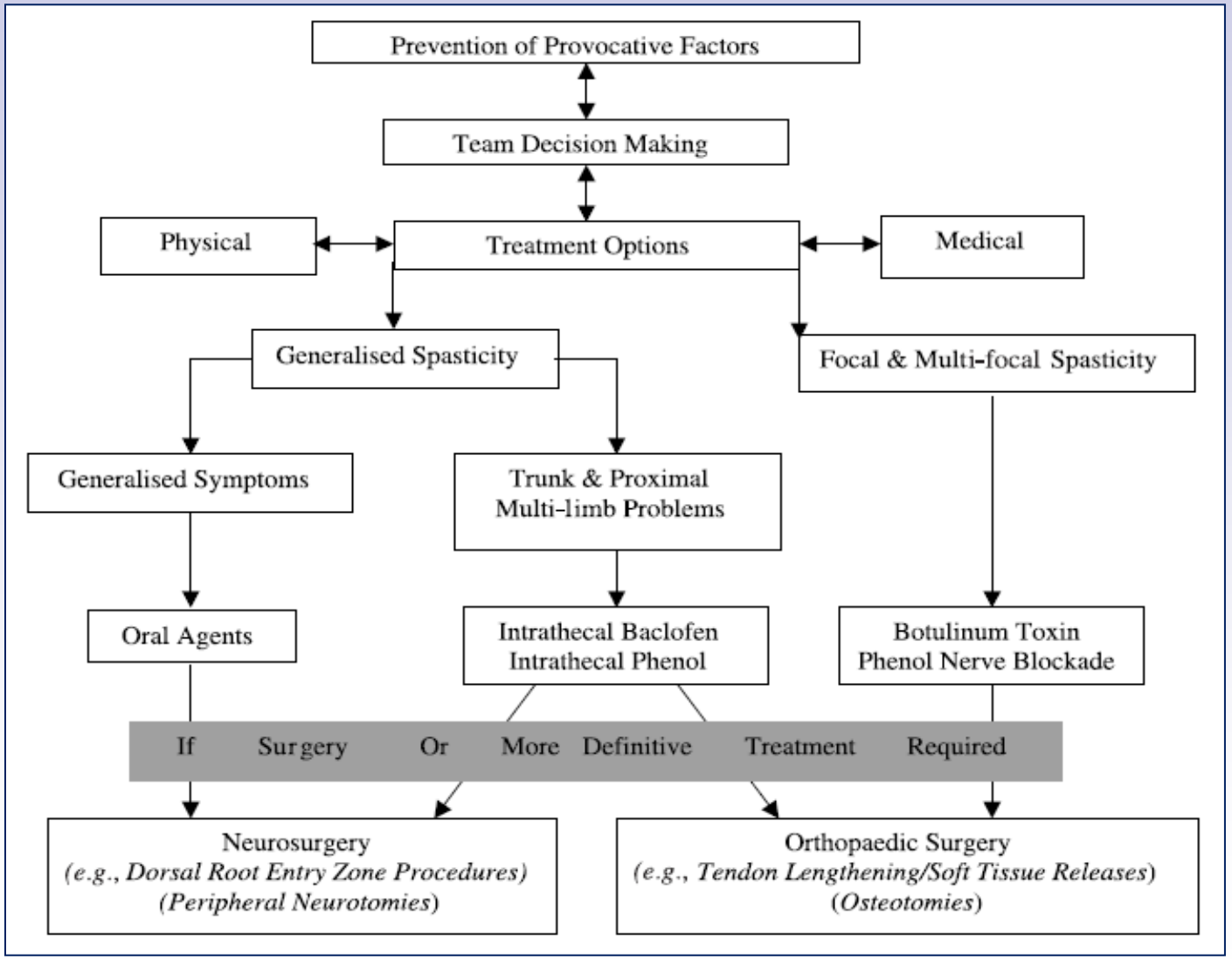
ASP MESSINA

U.O.C. Riabilitazione Adulti e Minori dell'Area Metropolitana

Dichiarazione conflitto di interessi

In ottemperanza a quanto richiesto dalla Commissione Nazionale ECM **dichiaro l'assenza del conflitto di interessi** ovvero l'assoluta autonomia dei contenuti scientifici del mio intervento ed indipendenza da interessi economici commerciali con possibili aziende sponsorizzatrici.

Gestione della spasticità

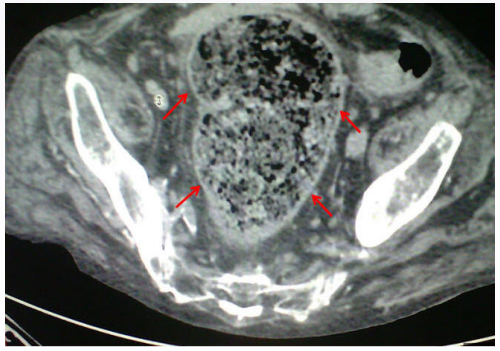


Ward, 2008

Fattori esacerbanti

- infezioni vie urinarie
- globo vescicale
- Fecalomi
- Infezioni
- altri problemi di salute
- Idrocefalo
- dolore

- lesioni cutanee da decubito
- unghia incarnita
- Malposizionamenti
- ortesi malposizionate
- vestiti stretti
- Ansia
- Fatica
- temperatura ambientale

Spasticità

Vantaggi

- Effetto stampella
- Mantenimento del trofismo muscolare
- Riduzione dell'osteopenia
- Ritorno venoso

Svantaggi

- Interferenza con le funzioni motorie residue
- Dolore
- Ulcere da decubito
- Difficoltà di nursing

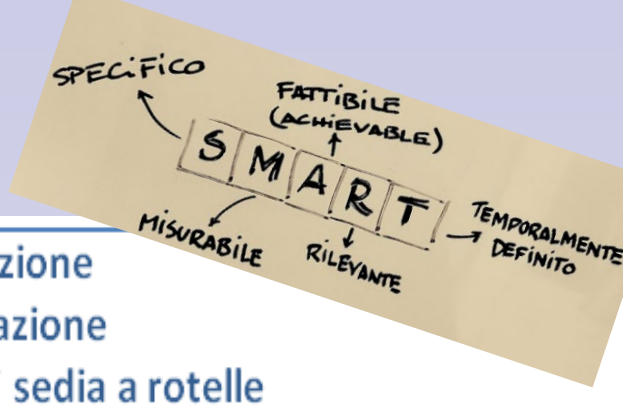
Non trattare la scala di Ashworth, ma la persona!

Obiettivi del trattamento della spasticità

WHO ICF	
Domain and goal area	Primary Code
Body functions	
Pain	b280
Passive movement/range	b735/710
Reducing associated reactions	b755
Simple hand/arm movements	b760
Activities and participation	
Upper limb activities	
Lifting and carrying objects	d430
Fine finger use/dexterity	d440
Holding, grasping objects	d445
Mobility	
Using upper limb for support/ balance	d415/d445
Improved walking/gait pattern	d450
Self care	
General Independence	d500
Hygiene /skin integrity	d520/d510
Dressing	d540
Eating/drinking	d550/560
Domestic	
Meal preparation/ cooking	d630
Household tasks	d640
Community	
Recreation/leisure/hobbies	d920

Nessuna menomazione	Menomazione lieve	Menomazione moderata	Menomazione severa	Menomazione completa	Non specificato	Non applicabile
0	1	2	3	4	8	9

OBIETTIVI



Miglioramento funzioni residue	- Mobilizzazione - Deambulazione - Utilizzo di sedia a rotelle - Equilibrio - Attività sessuale
Miglioramento Assistenza	- Igiene - Abbigliamento - Alimentazione - Posizionamento passivo
Miglioramento Comfort	- Riduzione dolore - Miglioramento del sonno - Tollerabilità delle ortesi
Prevenzione complicanze muscolo-schel./cutanee	- Contratture - Spasmi - Lussazioni - Piaghe da decubito
Cosmesi	Immagine corporea Utilizzo abiti e scarpe "regolari"

Goal Attainment Scale	
MUCH More than Expected Outcome	+2
MORE than Expected level of outcome	+1
EXPECTED Level of outcome	0
LESS than Expected level of outcome	-1
MUCH Less than expected Outcome	-2

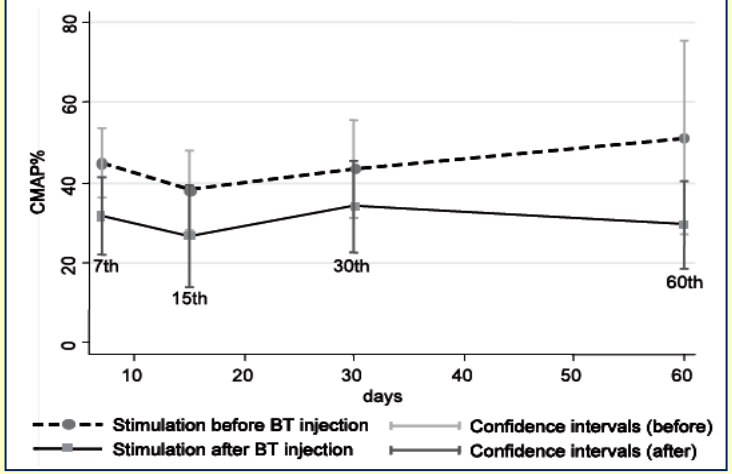
Razionale dell'utilizzo combinato tossina botulinica + altre strategie terapeutiche

- Migliorare l'assorbimento locale della tossina botulinica prolungandone gli effetti
- Prevenire e/o trattare le menomazioni secondarie dell'apparato muscolo scheletrico
- Migliorare le performance funzionali

MIGLIORAMENTO DELL'ASSORBIMENTO LOCALE

Stimolazione elettrica del muscolo infiltrato con Btx: effetto 'booster'?

Quando?



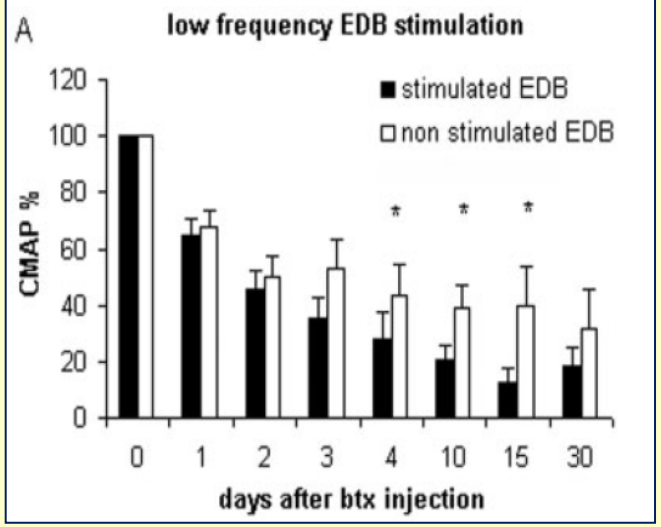
Santus G, 2011

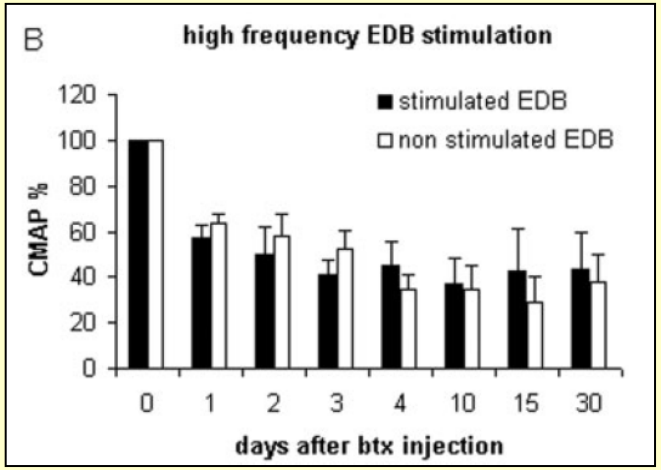
Per quanto tempo?

Protocollo di stimolo elettrico	
Singola sessione	15'-60'
N° sessioni tot.	5-60
N° sessioni/die	1-6
Durata protocollo	3 gg- 12 sett

Timing di assorbimento della Btx nel terminale colinergico (emivita): circa 12' (binding), circa 5' (internalization/traslocation) Simpson LL, 1980

Quale?





Frasson, 2005

Picelli A, 2021

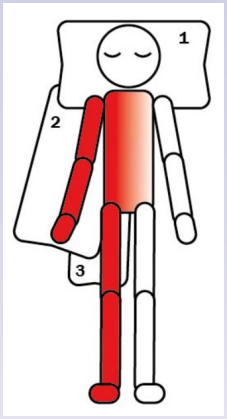
Tecniche di rinforzo dell'effetto della Btx	Studio	Pedro sc.; Livello di evidenza	Autori
Stimolazione elettrica (SE) *vs* Btx	RCT RCT	4/10; 2 5/10; 2	Hesse 1995; Hesse 1998
SE precoce vs SE tardiva	RCT	5/10; 2	Picelli, 2011
SE a bassa frequenza vs SE ad alta frequenza	RCT	4/10; 2	Frasson, 2005
SE vs **taping** vs stretching	RCT	6/10; 1	Baricich, 2008
Taping vs stretching + splint	RCT	8/10; 1	Santamato, 2015
Casting (1 sett) vs taping vs stretching	RCT	7/10; 1	Carda, 2011
ESWT (5 gg) vs SE	RCT	6/10; 1	Santamato, 2013
Splint dinamico vs BTX	RCT	2	Lai, 2009
Casting vs BTX	RCT	5/10; 2	Farina, 2008
Vibrazioni Segmentali (4 sett) vs Btx	RCT	8/10; 1	Paoloni, 2013

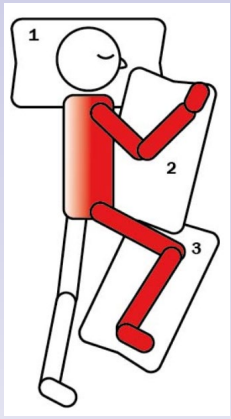
PREVENZIONE/TRATTAMENTO DELLE MENOMAZIONI SECONDARIE MUSCOLO-SCHELETRICHE

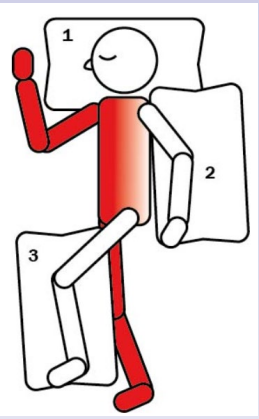
- Mobilizzazioni e stretching
- Posizionamenti corretti
- Casting/splinting/taping
- Rinforzo muscolare progressivo

POSIZIONAMENTI

- Riduzione riflessi patologici
- Riduzione frizioni cutanee
- Riduzione dolore
- Prevenzione contratture
- Prevenzione retrazioni







Stroke
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association | American Stroke Association

Positioning of Stroke Patients
Evaluation of a Teaching Intervention With Nurses

Anne Jones, MSc; Elizabeth K. Carr, PhD; Dianne J. Newham, PhD; Jenifer Wilson-Barnett, PhD

Mobilizzazioni/stretching

Obiettivi:

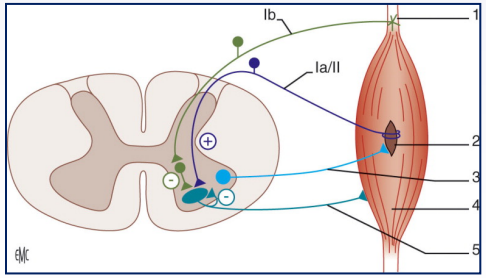
- Migliorare l'estensibilità dei tessuti molli
- Ridurre l'ipertono muscolare
- Migliorare il ROM articolare

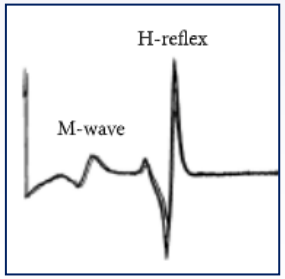
Rationale:

- Meccanico: proprietà reologiche tissutali
- Neurofisiologico: abitudine del riflesso tonico da stiramento; normalizzazione della depressione post-attivazione (Trompetto, 2014)

Modalità:

Attivo/passivo; breve/prolungato; manuale/meccanico; statico/dinamico





Smania, 2010

Arch Phys Med Rehabil. 2008 Jul;89(7):1395-406. doi: 10.1016/j.apmr.2008.02.015. Epub 2008 Jun 13.

The effects of stretching in spasticity: a systematic review.

Bovend'Eerdt TJ, Newman M, Barker K, Dawes H, Minelli C, Wade DT.

- The outcome measures used often assessed **impairments** such as available range of motion.
- Associated **functional** benefits were not usually investigated.
- Although there is some positive evidence supporting the **immediate effects** of a stretching session, it remains unclear how long these effects abide and its long-term consequences.

J Rehabil Med 2020; 52: jrm00005

REVIEW ARTICLE

Check for updates

JRM

DOES CASTING AFTER BOTULINUM TOXIN INJECTION IMPROVE OUTCOMES IN ADULTS WITH LIMB SPASTICITY? A SYSTEMATIC REVIEW

Jordan FARAG, MD[1,2] Rajiv REEBYE, MD[1,2], Carl GANZERT, MSc[5] and Patricia MILLS, MD, MHSc[1–4]
From the [1]Department of Medicine, University of British Columbia, [2]GF Strong Rehabilitation Centre, [3]International Collaboration on Repair Discoveries (ICORD), [4]Rehabilitation Research Program, Vancouver Coastal Health Research Institute, Vancouver, and [5]Hodgson Orthopedic Group, Coquitlam, BC, Canada

Table III. Levels of evidence

Level of evidence	Study	Recommendations
Level 1	RCT Carda et al. (18) (2011) Italy	In stroke patients with spastic equinovarus foot deformity, casting as an adjunct to BoNT injection to the ankle plantar flexors improves outcomes compared with the adjuncts stretching (for MAS, Ankle PROM, 6MinWT) and taping (for MAS, Ankle PROM).
Level 1	RCT Verplancke et al. (19) (2005) UK	In severely brain injured patients with lower limb spasticity, casting with or without BoNT injection prevents the development of equinovarus foot deformity compared with physical therapy alone. Casting with BoNT injection may result in less significant soft-tissue injury compared with casting with saline injection.
Level 4	Prospective pre-post study Singer et al. (20) (2003) Australia	In brain-injured patients with spastic equinovarus foot deformity, serial casting improved PROM and AnDT10. In a subset of patients who received BoNT in addition to casting, similar improvements were seen.
Level 4	Case series Yasar et al. (21) (2010) Turkey	In stroke patients with spastic equinovarus foot deformity, serial casting following BoNT improves ankle PROM, FIM and PRS.
Level 5	Case report Xu et al. (22) (2015) China	In one patient with recurrent peroneal spastic flatfoot, casting following BoNT improved MAS and PROM.

PROM: passive range of motion; MAS: Modified Ashworth scale; PRS: Physician Rating Scale; AnDT10: angle achieved at displacing torque of 10 Newton meters: EMG: electromyography; 6MinWT: 6-min walk test; 10MetWT: 10-m walk test; FIM: Functional Independence Measure.

- Ci sono evidenze di livello 1b che il casting è più efficace del taping e che il taping è più efficace dello stretching in termini di miglioramento di MAS, ROM, 6mWT, 10mWT (Carda, 2011).
- Btx+casting migliora MAS e baropodometria, ma non 10mWT (Farina S, 2008)
- Casting preferibile dopo Btx.

Stroke
Journal of the American Heart Association

The Effectiveness of the Bobath Concept in Stroke Rehabilitation

What is the Evidence?

American Heart Association | American Stroke Association

Boudewijn J. Kollen, PhD; Sheila Lennon, PhD; Bernadette Lyons, MSc; Laura Wheatley-Smith, BSc; Mark Scheper, MSc; Jaap H. Buurke, PhD; Jos Halfens; Alexander C.H. Geurts, MD, PhD; Gert Kwakkel, PhD

Background and Purpose—In the Western world, the Bobath Concept or neurodevelopmental treatment is the most popular treatment approach used in stroke rehabilitation, yet the superiority of the Bobath Concept as the optimal type of treatment has not been established. This systematic review of randomized, controlled trials aimed to evaluate the available evidence for the effectiveness of the Bobath Concept in stroke rehabilitation.

Method—A systematic literature search was conducted in the bibliographic databases MEDLINE and CENTRAL (March 2008) and by screening the references of selected publications (including reviews). Studies in which the effects of the Bobath Concept were investigated were classified into the following domains: sensorimotor control of upper and lower limb; sitting and standing, balance control, and dexterity; mobility; activities of daily living; health-related quality of life; and cost-effectiveness. Due to methodological heterogeneity within the selected studies, statistical pooling was not considered. Two independent researchers rated all retrieved literature according to the Physiotherapy Evidence Database (PEDro) scale from which a best evidence synthesis was derived to determine the strength of the evidence for both effectiveness of the Bobath Concept and for its superiority over other approaches.

Results—The search strategy initially identified 2263 studies. After selection based on predetermined criteria, finally, 16 studies involving 813 patients with stroke were included for further analysis. There was no evidence of superiority of Bobath on sensorimotor control of upper and lower limb, dexterity, mobility, activities of daily living, health-related quality of life, and cost-effectiveness. Only limited evidence was found for balance control in favor of Bobath. Because of the limited evidence available, no best evidence synthesis was applied for the health-related quality-of-life domain and cost-effectiveness.

Conclusions—This systematic review confirms that overall the Bobath Concept is not superior to other approaches. Based on best evidence synthesis, no evidence is available for the superiority of any approach. This review has highlighted many methodological shortcomings in the studies reviewed; further high-quality trials need to be published. Evidence-based guidelines rather than therapist preference should serve as a framework from which therapists should derive the most effective treatment. (***Stroke*. 2009;40:e89-e97.**)

Rinforzo muscolare

Muscolo antagonista

- l'attivazione dei mm antagonisti contrasta l'eccessiva contrattura del muscolo ipertonico.
- Inibizione dei muscoli agonisti spastici (inibizione reciproca)
- L'indebolimento dei mm agonisti (con btx) favorisce la comparsa della motilità residua (plasticità uso-dipendente)

Muscolo agonista (spastico)

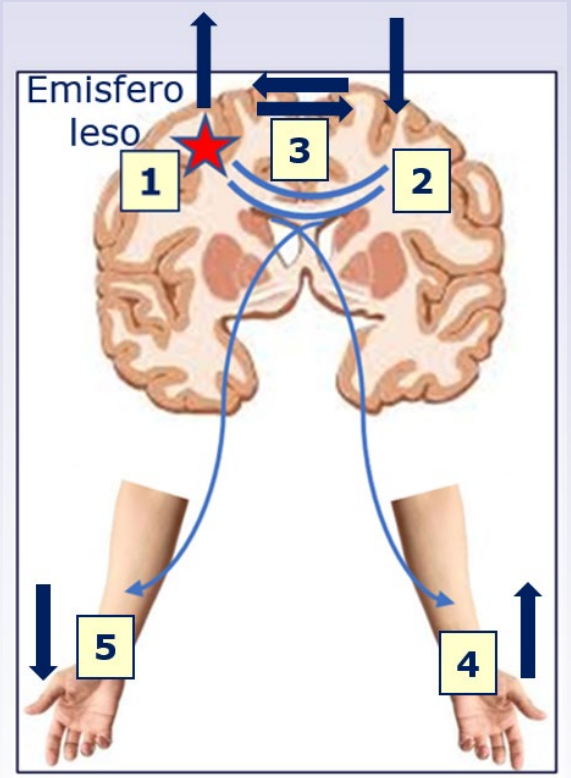
- Il rinforzo muscolare aumenta la spasticità?

⇩

- *Outcomes of progressive resistance strenght training following stroke: a systematic review.* Morris et al, 2004
- *Strenghtening interventions increase strenght and improve activity after stroke: a systematic review*. Ada et al, 2006
- *Strenghtening to promote functional recovery post stroke: an evidence-based review.* Pak et al, 2008

Miglioramento delle performance funzionali

Strategie riabilitative per il recupero motorio



1

Ipoattività emisfero lesionato:
- Training motorio: compito-specifico (*motor re-learning)*
- Motor imagery
- Motor Observation
- Mirror therapy
- CIMT/mCIMT
- Robotica
- NIBS eccitatoria

2

Iperattività emisfero sano:
- CIMT/mCIMT
- NIBS inibitoria

3

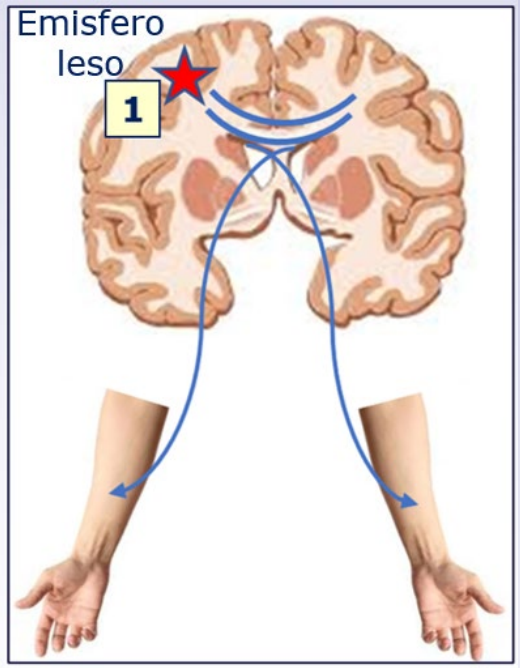
Abnorme inibizione interemisferica:
- NIBS eccitatoria/inibitoria

4

Ridotte afferenze all'emisfero leso:
- Mobilizzazioni, stretching, training propriocettivo
- Controllo sequenziale progressivo
- Terapia fisica: stimolazione elettrica, vibratoria

5

Aumento afferenze all'emisfero sano:
- CIMT



- Training motorio arto paretico : assistito, attivo, ‘task-oriented’ (*motor re-learning)*
- Motor imagery
- Motor Observation
- Mirror therapy
- N.I.B.S.

Allenamento ‘Task-oriented’

- Precoce
- Intensivo
- Ripetitivo
- Gesto funzionale
- Interessante
- Proporzionale
- Ripetitivo con cambiamenti

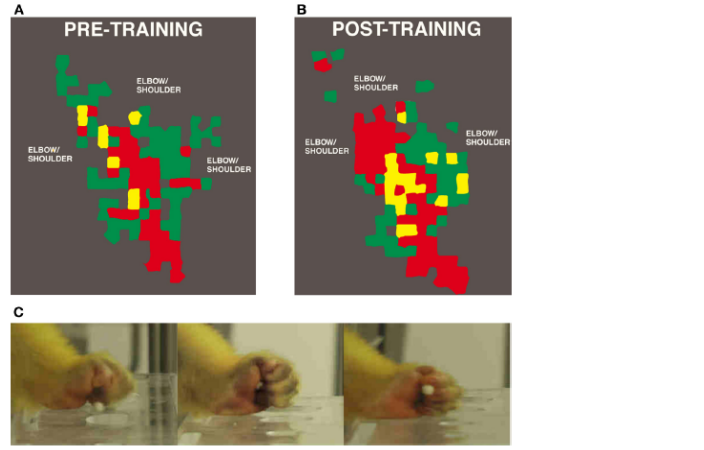


FIGURE 2 | Representation of distal forelimb representations in motor cortex after digit skill training as defined by intracortical microstimulation. Digit areas (red) expand after only 12 days of training. Combination movements that reflect the individual kinematics that the monkey employs also expand their representations. **(A)** Pre-training map. **(B)** Post-training map. **(C)** Still images of squirrel monkey retrieving food pellets from small wells (Nudo et al., 1996a).

Allenamento 'Task-oriented'

J Rehabil Med 2015; 47: 31–37

ORIGINAL REPORT

EFFECT OF REHABILITATION AND BOTULINUM TOXIN INJECTION ON GAIT IN CHRONIC STROKE PATIENTS: A RANDOMIZED CONTROLLED STUDY

Nicolas Roche, MD, PhD[1], Raphaël Zory, PhD[1,3], Antoine Sauthier[1], Celine Bonnyaud, PhD[1,2], Didier Pradon, PhD[1,2] and Djamel Bensmail, MD, PhD[1,2]

Table V. *Results of the functional tests*

	Rehabilitation group			Control group		
	V1 Mean (SD)	V2 Mean (SD)	Difference %	V1 Mean (SD)	V2 Mean (SD)	Difference %
Maximal gait speed (m/s)	1.2 (0.8)	1.3 (0.8)	8.3*, **	1.3 (0.8)	1.2 (0.5)	–4.4
Timed up and Go (s)	15.7 (6.9)	14.7 (5.9)	5.4**	14.6 (7.5)	14.5 (7.4)	–0.3
6MWT–modified (m)	301.0 (130.5)	315.5 (129.2)	7.1*	317.3 (114.5)	312.6 (112.1)	–1.0
6MWT–WO (m/s)	0.78 (0.3)	0.82 (0.3)	6.9*	0.83 (0.3)	0.81 (0.3)	–2.9
6MWT–NO (m/s)	0.92 (0.4)	0.95 (0.4)	7.1	0.95 (0.3)	0.95 (0.3)	1.8
Time to ascend stairs (s)	16.2 (5.8)	14.7 (5.8)	9.8*	19.4 (15.1)	21.1 (18.2)	–6.3
Time to descend stairs (s)	17.1 (8. 8)	16.4 (10.0)	6.6*, **	16.7 (9.3)	17.9 (10.4)	–7.8**

*Mann-Whitney *U* test $p<0.05$ for inter-group comparison (R vs C) of the percentage difference between V1 and V2.
**Wilcoxon test $p<0.05$ intra-group comparison between V1 and V2.

Table III. *Degree of spasticity for each muscle group (Modified Ashworth score for each muscle group (median value)*

Spasticity	RF V1	RF V2	H V1	H V2	Triceps V1	Triceps V2	GM V1	GM V2
Rehabilitation group	2	1+	1+	1	3	2	0	0
Control group	1+	1	0	0	2	1+	0	0

RF: rectus femoris muscle; H: hamstring muscles; triceps: soleus + gastrocnemius muscles; GM: gluteus muscles; V1: visit 1; V2: visit 2.

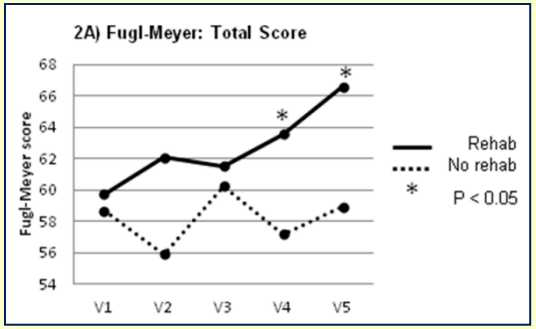
toxins

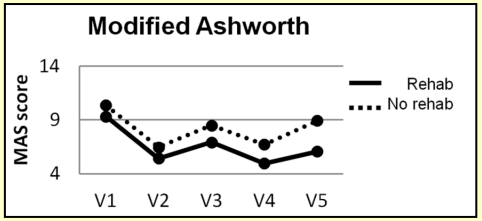
MDPI

Article

Rehabilitation plus OnabotulinumtoxinA Improves Motor Function over OnabotulinumtoxinA Alone in Post-Stroke Upper Limb Spasticity: A Single-Blind, Randomized Trial

Deidre Devier [1,*], JoAnn Harnar [2,3], Leandro Lopez [3], Allison Brashear [4] and Glenn Graham [5]



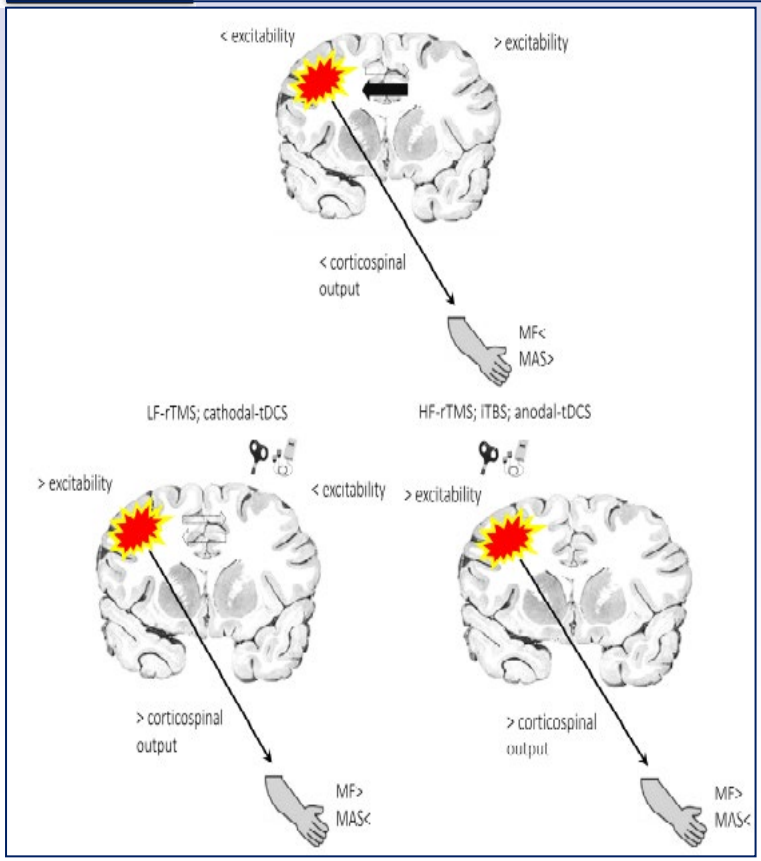


Abnorme inibizione interemisferica: N.I.B.S.

Narrative Review—CME

Spasticity Management: The Current State of Transcranial Neuromodulation

Antonino Leo PT, Antonino Naro MD, PhD, Francesco Molonia MS, Provvidenza Tomasello MS, Ileana Saccà MS, Alessia Bramanti PhD, Margherita Russo MD, PhD, Placido Bramanti MD ... See all authors

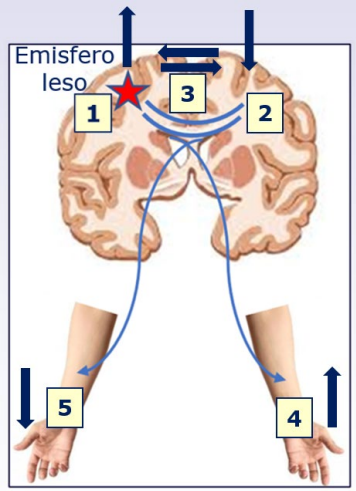


NIBS e spasticità: conclusioni

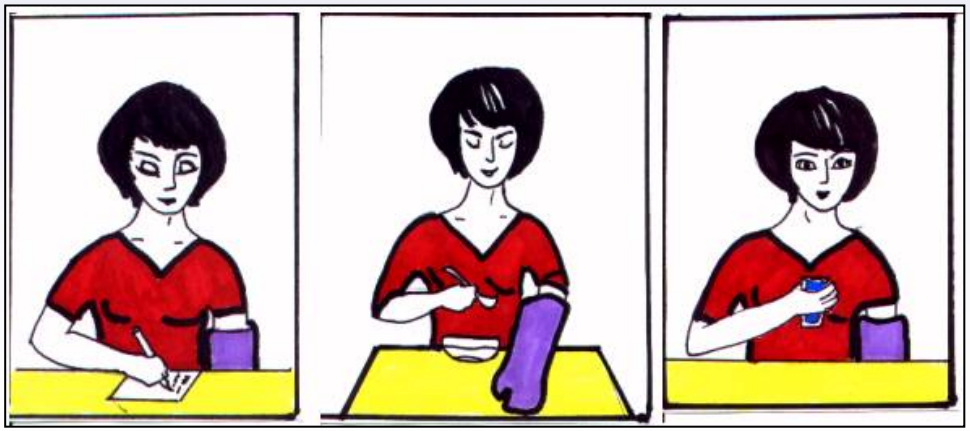
- NIBS è più efficace nel ridurre la spasticità quando utilizzata in ***add-on***.
- **Lf-rTMS e tDCS cath** sull'emisfero sano è più efficace nei pz con stroke cronico.
- **rTMS sembra avere effetti maggiori della tDCS** nel ridurre la spasticità sia in termini di grandezza che durata dell'effetto.
- La NIBS è più efficace nei pz con stroke rispetto a sclerosi multipla, SCI, PCI?
- L'applicabilità clinica degli studi eseguiti necessita di ulteriori conferme in RCTs multicentrici più ampi e con migliori disegni qualitativi.

2017

COSTRAINT-INDUCED MOVEMENT THERAPY (CIMT)

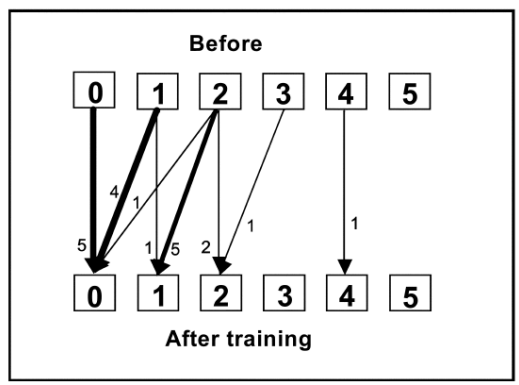


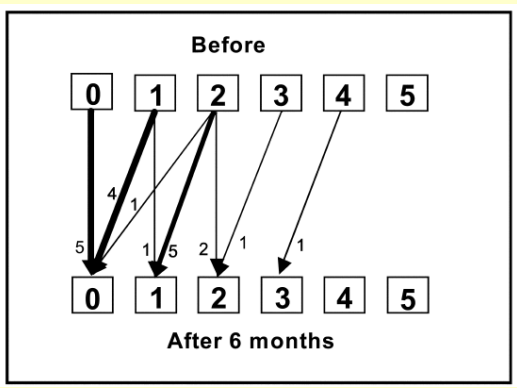
- Immobilizzazione arto sano
- Uso forzato arto paretico
- Allenamento intensivo 'task-oriented' arto paretico



<u>Rationale</u>

- Non uso appreso
- Competizione interemisferica
- Plasticità uso-dipendente





CIMT (Siebers, 2010)

Change in spasticity in the wrist flexors, measured by MAS before and after the 2-week training period (a) and after 6 months

Cochrane Library

Cochrane Database of Systematic Reviews

Constraint-induced movement therapy for upper extremities in people with stroke (Review)

Corbetta D, Sirtori V, Castellini G, Moja L, Gatti R

2015

Results of this review show a superiority of CIMT vs other rehabilitation approaches on the recovery from motor impairment and motor function (secondary outcomes) but not in disability (primary outcome).

Table 2. Mean Change From Baseline in the Modified Ashworth Scale[a] (MAS) Scores in the Combination Group[b]

	MAS Change (Elbow)				MAS Change (Wrist)				MAS Change (Finger)			
Patient	Baseline	4 Weeks	3 Months	6 Months	Baseline	4 Weeks	3 Months	6 Months	Baseline	4 Weeks	3 Months	6 Months
A1	3	−2	−2	−2	3	−2	−2	−2	3	−2	−2	−1
A2	4	−1	−1	−1	4	−2	−2	−1	4	−3	−2	−1
A3	4	−1	−1	−1	4	−1	−1	−1	4	−2	−2	−1
A4	3	−2	−2	−2	3	−3	−3	−2	4	−3	−3	−1
A5	3	−2	−2	0	3	−2	−2	−2	4	−3	−3	−1
A6	3	−2	−2	−2	3	−2	−2	−2	2	−2	−1	−1
A7	3	−2	−2	0	3	−2	−2	−2	4	−3	−3	−2
A8	3	−2	−2	−2	1	−1	0	0	2	−1	−1	−1
A9	4	−3	−2	−1	3	−2	−1	−1	3	−3	−2	−1
A10	3	−2	−2	−2	1	−1	−1	0	3	−2	−2	−2
A11	3	−2	−2	−2	1	−1	−1	0	2	−2	−2	−1
A12	3	−2	−2	0	4	−3	−3	−1	4	−2	−2	−1
A13	3	−3	−2	0	3	−2	−2	−2	3	−2	−2	−2
A14	3	−2	−2	−2	3	−1	−1	−1	3	−3	−3	−2
A15	3	−2	−1	0	3	−1	−2	0	3	−2	−1	−1
	3.2 ± 0.4 (3)	−2.0 ± 0.5[c] (−2)	−1.8 ± 0.4[c] (−2)	−1.1 ± 0.9[d,e] (−1)	2.8 ± 1.0 (3)	−1.7 ± 0.7[d] (−2)	−1.7 ± 0.8[d] (−2)	−1.1 ± 0.8[d,e] (−1)	3.2 ± 0.8 (3)	−2.3 ± 0.6[c] (−2)	−2.1 ± 0.7[d] (−2)	−1.3 ± 0.5[c,f] (−1)

[a]MAS score range: 0 to 5.
[b]Values are mean ± standard deviation with medians in parentheses.
[c]Within group: $P < .001$ when compared with baseline values.
[d]Within group: $P < .05$ when compared with baseline values.
[e]Between groups: $P < .05$ when compared with the control group.
[f]Between groups: $P < .001$ when compared with the control group.

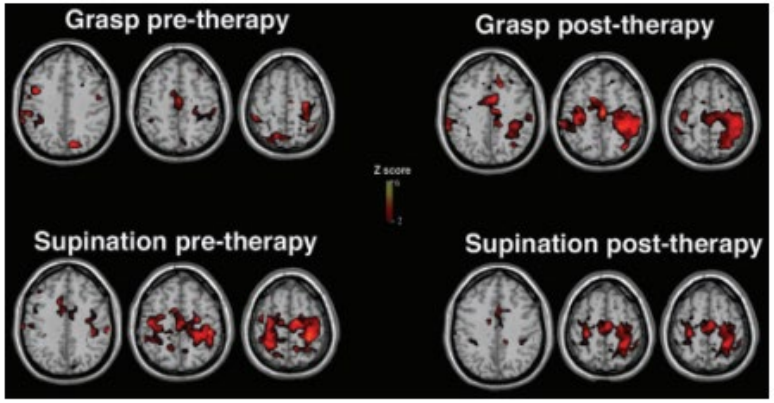
Btx +CIMT (Sun, 2010)

The combination group showed significantly greater improvements in elbow, wrist, and finger spasticity, real-world arm function and laboratory motor activity than the control group at 6-month postinjection

Training robotizzato: vantaggi

- Riabilitazione precoce
- Intensiva
- Ripetitiva
- Task-oriented
- Ambiente arricchito
- Fornisce feedback real-time sulla prestazione
- Coinvolgente e motivante
- Partecipazione “attiva” del paziente
- Dual-task
- Strumento di valutazione oggettivo
- Training standardizzato
- Allevio del terapista

EFFETTI POSITIVI SUI MECCANISMI DI APPRENDIMENTO E SULLA NEUROPLASTICITÀ



A robot based therapy showed improvement in **motor hand function** after chronic stroke. **Reorganization of motor maps was task-specific** (Takahashi C D, Brain 2008)

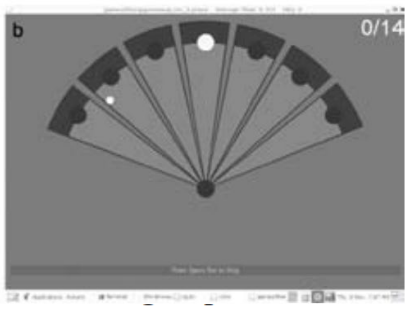
Dispositivi robotici per arto superiore: tono muscolare

J Rehabil Med 2010; 42: 279–281

SHORT COMMUNICATION

UPPER LIMB SPASTICITY REDUCTION FOLLOWING ACTIVE TRAINING: A ROBOT-MEDIATED STUDY IN PATIENTS WITH CHRONIC HEMIPARESIS

Federico Posteraro, MD[1], Stefano Mazzoleni, PhD[2], Sara Aliboni, MD[3], Benedetta Cesqui, MScME[2,4], Alessandro Battaglia, MD[3], Maria Chiara Carrozza, PhD[2], Paolo Dario, PhD[2] and Silvestro Micera, PhD[2,5]



Conclusion: **Comparison between groups confirms that active movement training does not result in increased hypertonia, but results in spasticity reduction in antagonist muscles by activating the reciprocal inhibition mechanism. Furthermore, robot-mediated therapy contributes to a decrease in motor impairment of the upper limbs in subjects with chronic hemiparesis, resulting in a reduction in shoulder pain.**

CONFERENZA NAZIONALE DI CONSENSO
LA RIABILITAZIONE ASSISTITA DA ROBOT E DISPOSITIVI ELETTROMECCANICI PER LE PERSONE CON DISABILITA' DI ORIGINE NEUROLOGICA **2022**

S.I.R.N.

Studio	Robot	Tono mm.	controllo motorio	Follow-up
		MAS	FMA	
Taveggia, 2016 (RCT, 54 pz)	Esoschel.	+		+ 6 sett.
Franceschini, 2019 (RCT, 48 pz)	End-effect.	+		+ 6 mesi
Hung, 2019 (RCT, 30 pz)	End-effect.	+	+	
Veerbeeck, 2017 (Metanalisi 44 RCTs, 1362 pz)		-	+	

- Non vi sono evidenze sufficienti per concludere che la terapia robotica possa migliorare il tono muscolare.
- Non sono stati segnalati effetti negativi sul tono muscolare in seguito a trattamento robot-assistito, anche se spesso la spasticità marcata può essere considerata un fattore di esclusione alla terapia stessa.

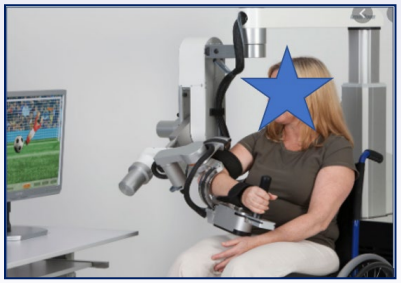
Dispositivi robotici per arto superiore: evidenze scientifiche

Dominio ICF: Funzioni corporee

- Effetti positivi sul **controllo motorio** (FMA) e sulla **forza muscolare** (MRC)
- Non vi sono evidenze sufficienti per concludere che la terapia robotica possa migliorare il tono muscolare ed il dolore

Dominio ICF: Attività e Partecipazione

- Sono ipotizzabili effetti positivi su **funzionalità** dell'arto superiore (ARAT, Wolf Motor Function Test, Frenchay Arm Test), **destrezza** (Box & Block Test, Nine Hole Peg Test), **utilizzo dell'arto superiore** (Motor Activity Log), **abilità globale** (BI, BIM, FIM).
- Assenza di ricadute sulla 'partecipazione'



Dispositivi robotici per arto inferiore

Review Article

Effects of Robot-Assisted Gait Training in Individuals with Spinal Cord Injury: A Meta-analysis

Chia-Ying Fang,[1] Jia-Ling Tsai,[2] Guo-Sheng Li,[1] Angela Shin-Yu Lien,[2,3,4] and Ya-Ju Chang[1,3,5]

Background. To investigate the effects of robot-assisted gait training (RAGT) on spasticity and pain in people with spinal cord injury (SCI). *Material and methods.* Four electronic databases (PubMed, Scopus, Medline, and Cochrane Central Register of Controlled Trials) were searched for studies published up to November 2019. Only human trials and of English language were included. The searched studies were reviewed and extracted independently by two authors. Randomized controlled trials (RCTs) and non-RCTs were pooled separately for analyses. Primary outcome measures included spasticity assessed by Ashworth scale (AS) or modified Ashworth scale (MAS) and pain assessed by VAS. Secondary outcome measures included lower extremity motor score (LEMS) and walking ability (i.e., 6-minute walk test, 10-meter walk test). *Results.* A total of 225 studies were identified. Eighteen studies (7 RCTs and 11 non-RCTs) including 301 subjects met inclusion criteria. The outcome measure of spasticity significantly improved in favor of RAGT group in non-RCTs (AS: 95%CI = −0.202 to -0.068, $p \leq 0.001$; MAS: 95%CI = −2.886 to -1.412, $p \leq 0.001$). The results on pain did not show significant change after RAGT in either RCTs or non-RCTs. LEMS and walking ability significantly increased in favor of RAGT. *Conclusions.* RAGT can improve spasticity and walking ability in people with SCI. The probable reason for no significant change in pain after RAGT is floor effect. RAGT is beneficial for normalizing muscle tone and for improving lower extremity function in people with SCI without causing extra pain.

2020

- La terapia robot assistita ha un buon **profilo di sicurezza e tollerabilità.**
- È indicata in **complementarietà** e non in alternativa alla terapia convenzionale.
- Le potenzialità di recupero dell'arto superiore e del cammino sono presenti sia **in fase subacuta che cronica**.
- **Limiti attuali**: quale tipo di dispositivo robotico? Quale posologia? Chi sono i soggetti 'responders'?

Nuovi approcci riabilitativi: trattamenti combinati

PLOS ONE

RESEARCH ARTICLE

Is two better than one? Muscle vibration plus robotic rehabilitation to improve upper limb spasticity and function: A pilot randomized controlled trial

Rocco Salvatore Calabrò[1☯]*, Antonino Naro[1☯], Margherita Russo[1], Demetrio Milardi[1,2], Antonino Leo[1], Serena Filoni[3], Antonia Trinchera[1], Placido Bramanti[1]

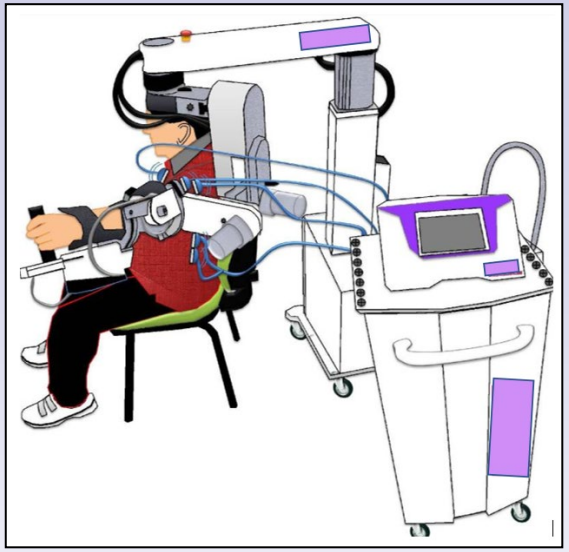
	group	T0	T1	T2	Post-hoc T1	Post-hoc T2	d
MAS	A	3.4±0.9	2±0.6	3±0.6	<0.001	0.007	0.6
	B	3.2±0.8	2.4±0.7	3.2±0.5	0.3	0.4	
SICI (%)	A	80±2	51±2	50±3	<0.001	<0.001	0.7
	B	79±3	69±3	81±3	0.5	0.1	
HMR (%)	A	130±3	81±4	89±5	<0.001	<0.001	0.7
	B	131±3	96±4	128±3	0.3	0.5	

Legend: MAS Modified Ashworth Scale, SICI short intracortical inhibition, HMR H_{max}/M_{max} ratio, NS non-significant.

	group	T0	T1	T2	Post-hoc T1	Post-hoc T2	d
FIM Six-items	A	21±2	26±3	25±2	<0.001	0.01	0.7
	B	31±2	33±2	32±1	0.2	0.3	
FMA-UE	A	23±14	37±8	26±6	0.001	0.007	0.4
	B	22±17	26±4	27±5	0.04	0.3	
HRS-A	A	10±5	7±2	7±2	0.001	0.001	0.7
	B	8±4	8±2	8±2	0.1	0.2	
HRS-D	A	19±5	11±3	11±3	0.001	0.001	0.6
	B	21±2	18±4	18±4	0.2	0.5	
MEP (mV)	A	0.41±0.1	0.5±0.1	0.52±0.1	0.001	0.007	0.8
	B	0.38±0.1	0.4±0.1	0.41±0.1	0.3	0.4	
ICF (%)	A	111±8	112±8	115±10	0.4	0.3	0.1
	B	109±8	109±7	110±8	0.1	0.2	

Legend: FIM Functional Independence Measure, FMA-UE Fugl-Meyer Assessment, HamD Hamilton Rating Scale for depression, HamA Hamilton Rating Scale for anxiety, MEP motor evoked potential, ICF intracortical facilitation, NS non-significant.

Calabrò, 2017



Altri trattamenti combinati

Robot + terapia convenzionale	Lyle RC et al
Robot + FES	Giacobbe V et al, 2013
Robot + rTMS	Millot MH, 2014
Robot + tDCs	Giacobbe V, 2013- Simonetti D, 2017
Robot + Realtà virtuale	Frisoli A, 2007- Takahashi CD et al, 2008
Robot + tossina botulinica	Pennati GV et al, 2015

Onde d'urto e spasticità degli arti superiori

Authors	Year	Sample (N)	Age (y)	Gender (M/F)	Duration (mo)	Stroke (I/H)	Outcomes	Side Effects
Manganotti and Amelio [35]	2005	20	63.0	11/9	>9	15/5	MAS (+), ROM (+), EMG (−)	not specified
Santamato et al. [36]	2013	16	64.4	9/7	10.5	8/8	MAS (+), SFS (+), VAS (+)	none
Troncati et al. [37]	2013	12	48.0	1/11	not specified	6/6	MAS (+), FMA (+), ROM (+)	not specified
Daliri et al. [38]	2015	15	54.4	12/3	≥6	13/2	MMAS (+), BRS (−), EMG (+)	not specified
Dymarek et al. [39]	2016	30	61.4	11/19	26–77	30/0	MAS (+), sEMG (+), IRT (+)	none
Dymarek et al. [40]	2016	20	63.1	13/7	9–120	20/0	MAS (+), sEMG (+), IRT (+)	none
Li et al. [41]	2016	20	55.4	12/8	9–144	10/10	MAS (+), FMA (+)	none
Kim et al. [44]	2016	17	59.9	7/10	4–60	8/9	VAS (+), CMS (+), ROM (−), FMA (−), MAS (−)	petechiae, bulla
Yoon et al. [56]	2017	26	58.7	26/0	2–198	not specified	MAS (+), MTS (+)	not specified
Yoon et al. [56]	2017	28	63.1	27/1	2–198	not specified	MAS (+), MTS (+)	not specified
Wu et al. [42]	2018	21	60.0	8/13	>60	11/9	MAS (+), ROM (+), FMA (+)	none
Park et al. [43]	2018	15	64.2	9/6	8.1	10/5	FMA (+), STM (+)	not specified
Li et al. [44]	2020	27	65.0	20/7	>1	24/3	MAS (+), VAS (+), MTS (+), FMA (−)	not specified

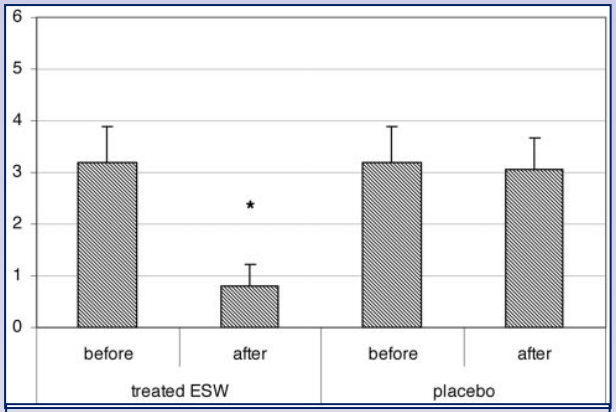
Opara J, 2021

Onde d'urto e spasticità degli arti inferiori

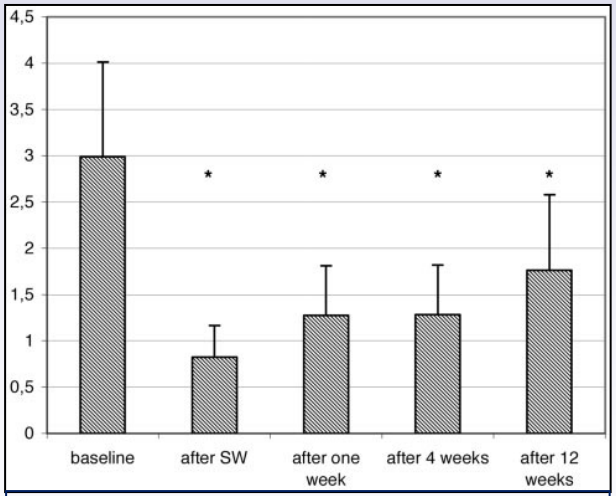
Authors	Year	Sample [N]	Age [y]	Gender [M/F]	Duration [mo]	Stroke [I/H]	Outcomes	Side Effects
Sohn et al. [46]	2011	10	44.9	6/4	23–77	2/8	MAS (+), EMG (−)	not specified
Moon et al. [47]	2013	30	52.6	17/13	80.5	16/14	MAS (+), ROM (−), FMA (−), IDT (+)	none
Santamato et al. [48]	2014	23	51.6	15/8	24.9	12/11	MAS (+), ROM (+), EMG (−)	pain, weakeness
Kim et al. [49]	2015	10	64.1	5/5	17.6	5/5	STM (+), VAS (+), VGA (+)	not specified
Radinmehr et al. [50]	2017	12	59.0	7/5	34.0	6 /6	MMAS (+), ROM (+), IKD (+), TUG (+), EMG (−)	none
Sawan et al. [51]	2017	20	50.6	9/4	6–18	not specified	EMG (+), ROM (+), 10-mWT (+)	not specified
Taheri et al. [52]	2017	14	44.0	9/4	12–55	11/2	MAS (+), VAS (+), ROM (+), 3-mWT (+), LEFS (+)	not specified
Yoon et al. [56]	2017	13	61.0	13/0	12–184	not specified	MAS (+), MTS (+)	not specified
Yoon et al. [56]	2017	13	66.9	13/0	15–87	not specified	MAS (+), MTS (+)	not specified
Wu et al. [53]	2018	31	59.9	18 /13	50–55	20/11	MAS (+), MTS (+), ROM (+), 10-MWT (+), FPMP (+)	none
Lee et al. [54]	2018	9	50.0	7/2	>3	4/5	MAS (+), ROM (+), FMA (+), USG (+)	not specified
Radinmehr et al. [50]	2019	16	60.0	9/7	>1	not specified	MMAS (+), ROM (+), IKD (+), TUG (+), EMG (−)	none

Opara J, 2021

Onde d'urto (ESW)



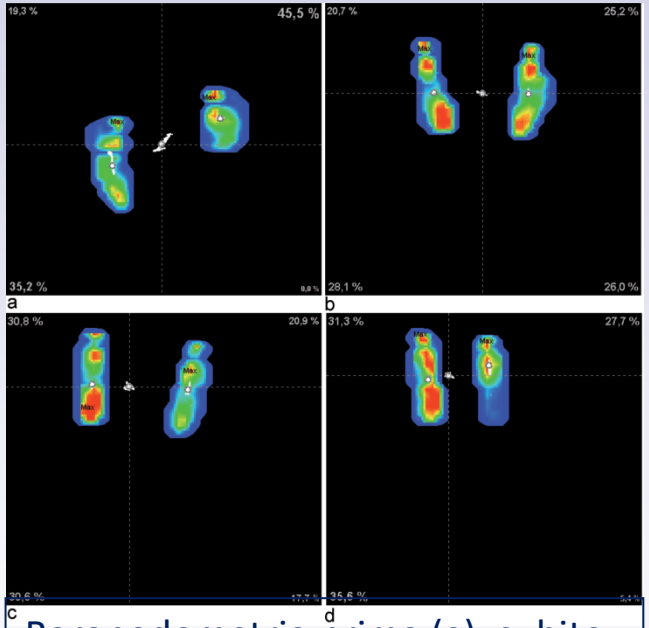
Ashworth dei flex dita prima e dopo ESW/placebo



Ashworth dei flex dita

Variables	Baseline Mean (SD)	Immediately after placebo Mean (SD)	Immediately after ESWT Mean (SD)	After 1 week Mean (SD)	After 4 weeks Mean (SD)	After 12 weeks Mean (SD)	*p*-value Mean (SD)
Ashworth plantar flexors	3.3 (0.49)	3.1 (0.38)	1.8 (0.38)*	1.9 (0.51)*	2.25 (0.45)*	2.8 (0.57)	<0.001
pROM(°)	20 (7)	20 (6)	50 (6)*	50 (7)*	40 (6)*	30 (8)	<0.001
Plantar surface area (cm^2)	40.31 (5)	43.15 (6)	80.23 (7)*	70.12 (5)*	68.09 (8)*	48.23 (6)	<0.001
peak pressure value (kpa)	20.5 (4)	22.1 (6)	99.57 (9)*	95.06 (6)*	70.11 (8)*	30.4 (9)	<0.001

*$p<0.001$ with Bonferroni correction.
pROM: passive range of motion.



Baropodometria prima (a), subito (b), 1 sett (c) e 4 sett (d) dopo ESW

ESWT reduces hypertonia of the wrist and finger muscles for 12 weeks after treatment (Manganotti et al, stroke 2005)

A single ESW produces a long-lasting reduction in hypertonia in the plantar flexors in children with cerebral palsy (Amelio e Manganotti, J Rehabil Med 2010)

Onde d'urto (ECSW)

Nei pz con stroke
- ✓ ↓ tono muscolare mm flessori plantari
- ✓ Miglioramento del pROM dorsiflessione caviglia
- ✓ Effetto di lunga durata se I-II-III grado Heckmatt (**ecografia di muscolo**)
- ✓ Effetto di breve durata se IV grado Heckmatt (Santamato et al, 2014)

Plurime sessioni di rECSW vs singola sessione di rECSW: effetto miorilassante più marcato e duraturo dopo **plurime sessioni** (Tsung-Ying Li, 2016)

Non ci sono differenze significative tra la stimolazione con fECSW del **ventre muscolare o della giunzione miotendinea (**Yoon et al 2017).

Nell'unico studio comparativo che valuta gli effetti delle **rSWT e fSWT** nella spasticità post-stroke è stato riportato che la spasticità si riduce in maniera simile dopo r e fSWT (Wu et al, 2017).

ESW + BTX-A è più efficace di stimolazione elettrica + BTX-A (↓ tono muscolare, spasmi, dolore nei pazienti con stroke (SBOTE study, Santamato et al, 2013)

Meccanismo d'azione: ?, ↑ sintesi NO, ↓ eccitabilità motoneuronale, modificazioni permeabilità membrana cellulare, meccanotrasduzione, modificazioni reologiche muscolari.

European Journal of Physical and Rehabilitation Medicine 2014 Ottobre;50(5):525-32

Management of stroke patients submitted to botulinum toxin type A therapy: a Delphi survey of an Italian expert panel of specialist injectors

Franceschini M. [1], Iocco M. [2], Molteni F. [3], Santamato A. [4], Smania N. [5]

1. Individuare obiettivi specifici insieme a pz e caregiver
2. Effettuare 1 sessione di stimolazione elettrica muscolare entro la I ora dall'infiltrazione
3. Avviare un programma riabilitativo precoce (entro la I settimana dall'infiltrazione): setting multidisciplinare
4. Addestrare il caregiver
5. Stretching (anche prolungato), mobilizzazione
6. Rinforzo mm antagonisti, S.E. mm. antagonisti, FES
7. CIMT, Motor imagery, Motor Observation, Task-oriented training
8. Follow up: 1 mese, 3-6 mesi
9. Infiltrazioni successive: > 3 mesi (il proseguimento di FKT prolunga l'effetto di BTX)
10. Chirurgia funzionale: dopo 12-24 mesi (fallimento di BTX)

Grazie per l’attenzione