

Therapy with a robotic touch



Clinical Studies

In this presentation:

- ❑ Total number of studies
- ❑ Publications
- ❑ Key clinical studies
 - Israel: sub acute stroke
 - Germany: sub acute stroke
 - Italy: chronic stroke
 - Japan: sub acute stroke
- ❑ New article
- ❑ General conclusions
- ❑ Ongoing studies



- ❑ The ReoGo was launched in rehab centers in 2007
- ❑ Clinical studies focused on Efficacy, Safety and patients satisfaction
- ❑ New directions in ReoGo therapy include combined use with EEG or EMG
- ❑ In many cases we only learn about such studies after they are published
- ❑ In this presentation we will discuss the main publications

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❑ **Total number of studies :** 13

➤ 9 completed

➤ 4 ongoing

❑ **No. of patients :** ~350

❑ **Sites :** USA, Japan, Italy,
Germany, Israel

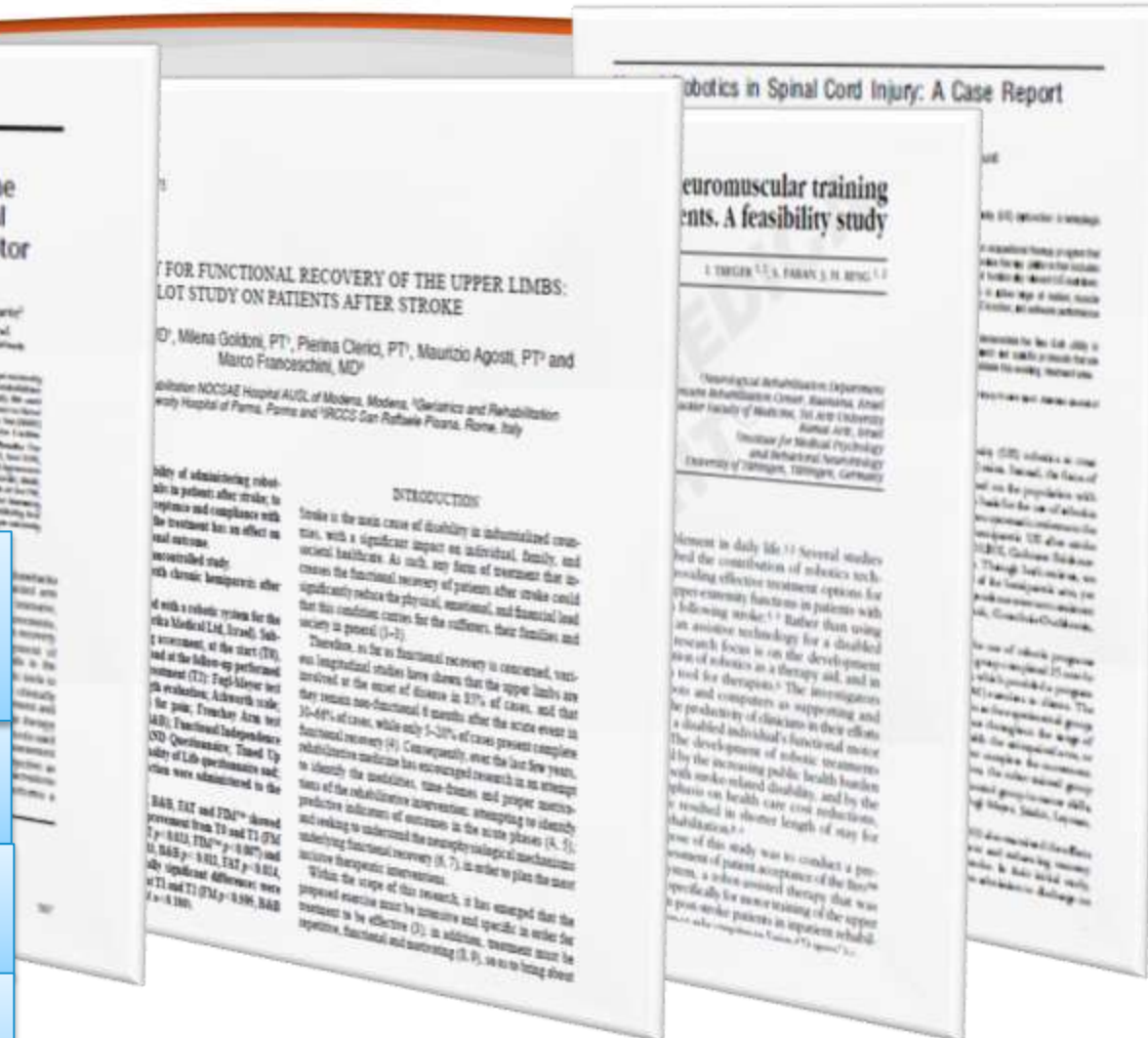


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European Journal of physical and Rehabilitation , 2008, Israel



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Robot- assisted therapy for neuromuscular training of sub-acute stroke patients

A feasibility study

I. Treger, S. S.Faran, H. Ring,

Israel, 2008

European Journal of physical and Rehabilitation Medicine

Objective:

- ❑ Preliminary assessment of **patient acceptance** of an upper extremity ReoGo Robot Therapy

Design:

- ❑ 10 **sub acute stroke** patients
- ❑ **15 sessions of 45 minutes** of ReoGo treatment in addition to physical and occupational therapy

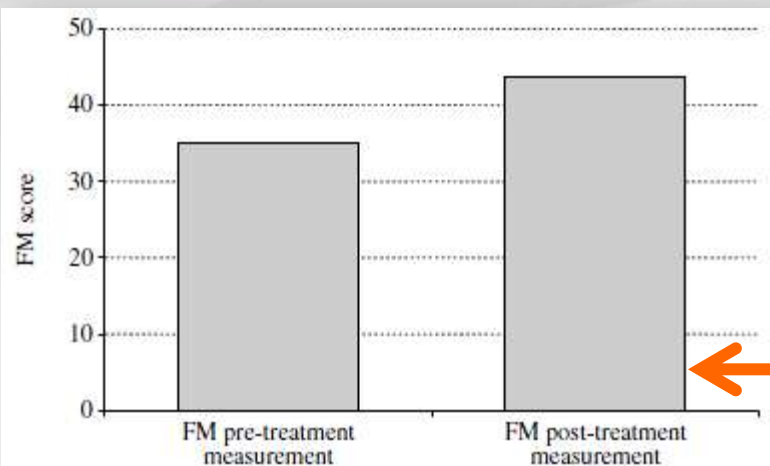


Figure 3.—Fugl-Meyer values.

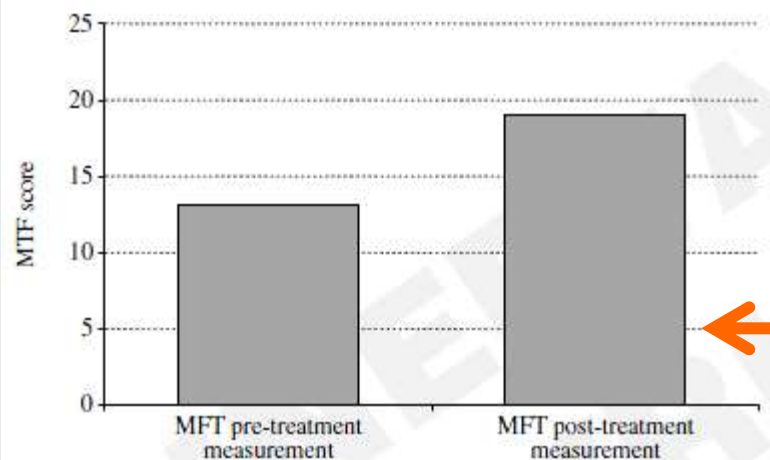


Figure 4.—Manual Function Test values.

Results

Motor impairment was significantly improved in the Robot- assisted upper arm therapy

TABLE I.—Results of acceptance feedback questionnaire, Fugl-Meyer and Manual Function Test.

	Mean values		P values
	After 1 week of treatment	After 3 weeks of treatment	
Acceptance of Reo™ Therapy System Feedback Questionnaire (max. value = 75)	54	65	0.006*
	Pretreatment	Post-treatment	
Fugl-Meyer Test	35.0	43.5	0.001*
Manual Function Test (proximal part only)	8.2	10.3	0.01*
Manual Function Test (distal part only)	5.0	8.7	0.005*
Manual Function Test (overall)	13.2	19.0	0.002*

*Statistically significant.

Conclusions

- ❑ Motor impairment was significantly improved in the ReoGo upper arm therapy
- ❑ Excellent patients compliance
- ❑ High patient motivation led to a high number of repetitions of functional movement per session

What is the average number of repetitions per session
of **ReoGo** therapy vs. **physiotherapy**?



Average Repetitions Per Session



210 (SD 54)

23 min. (SD 6)



32* (20- 44)

36 min. +/- 14

Increased number of repetitions, better brain recovery

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Active and repetitive robot assisted training improves the functional recovery of the arm in sub-acute stroke patients

S. Faran, S. van Kaick, C. Eickhoff, K-H. Mauritz

Germany, 2008

International Stroke Conference, New Orleans, LA

Objective:

- ❑ To determine whether motor training with the ReoGo for 60 minutes daily as compared to splint therapy will lead to significant improvement in :
 - Selective arm motor control
 - Arm activities

Design:

- ❑ 20 sub-acute stroke patients, with first ischemic stroke onset 3 weeks- 3 months prior to treatment
- ❑ Two groups
- ❑ **Treatment protocol:**
 - Daily therapy sessions
 - 4 weeks
 - 20 sessions of one hour
 - ReoGo or air splint therapy

Main Outcome Measures:

- ☐ Fugl Meyer (FM) test
- ☐ Action Research Arm Test (ARAT)

The tests were performed at baseline and after 4 weeks

Results:

□ FM:

Significant improvement in the ReoGr treatment (**11.09 points**)

□ ARAT:

Significant improvement in the ReoGr treatment (**14.3 points**)

□ FM and ARAT Vs Motor Power Scale at Baseline:

improvement (delta from baseline) in the Reo therapy was considerably higher for patients entering the therapy with higher motor power.

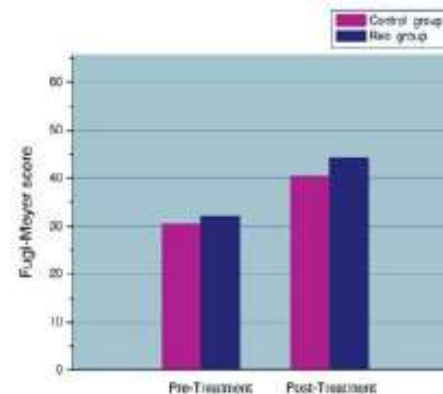


Fig. 2 Fugl-Meyer differences between the two groups pre and post treatment

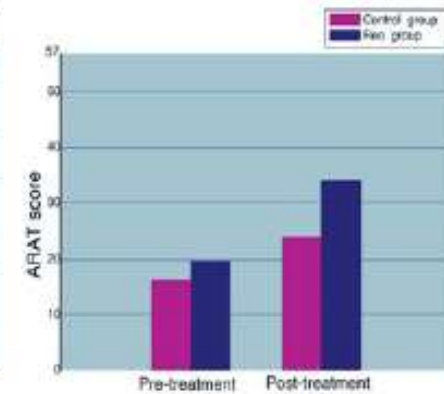


Fig. 3 ARAT differences between the two groups pre and post treatment

Conclusions:

❑ Motor recovery of the upper limb in hemiplegic stroke patients can be significantly improved through additional sensori-motor training in the sub-acute phase.

❑ The score of the Fugl-Meyer in the Reo group improved by 18.2%, a difference that can be considered to be clinically relevant.

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**Robot-aided therapy for upper limbs in patients
with stroke-related lesions. Brief report of a
clinical experience**

2011, Italy

F. Bovolenta, M. Goldoni, P. Clerici, M. Agosti, M. Franceschini

JOURNAL OF NEUROENGINEERING AND REHABILITATION

Objectives

- ☐ To verify the improvement of the **motor impairment** and functionality after a rehabilitation treatment with the ReoGo™
- ☐ To verify the **persistence** of the effects after 1 month.
- ☐ To evaluate patients' degree of **acceptance and compliance** with the treatment

Design:

- ☐ 19 patients (13 males, 6 female) with chronic hemiparesis
- ☐ Average age 55.74 (± 12.6) years
- ☐ First acute event of cerebrovascular stroke
- ☐ Unsuccessful conclusion of a previous rehabilitation program

Treatment protocol:

- ☐ 20 sessions with ReoGo robotic system
- ☐ 45 min each
- ☐ 5 days a week, 4 weeks

Main Outcome Measures:

- Fugl -Meyer (FM) test,
- Medical Research Council (MRC),
- Ashworth scale
- Visual Analogue Scale pain
- Frenchay Arm test
- Box and Block test,
- FIM motor
- Time up and Go test
- Euro Quality of Life
- Visual Analogue scale satisfaction



Results

Table 3 Performance at the clinical assessment tasks

		T-1 (N = 19)			T0 (N = 19)			T1 (N = 19)			T2 (N = 16)			M
		Mean \pm Std. Dev.	Median	Min; Max	Mean \pm Std. Dev.	Median	Min; Max	Mean \pm Std. Dev.	Median	Min; Max	Mean \pm Std. Dev.	Median	Min; Max	
Fugl-Meyer Test (n = 18)	<i>Upper Limb</i>	31.33 \pm 17.42	33.5	5; 54	31.21 \pm 16.92	33	7; 55	40.37 \pm 18.57	49 ^b	9; 62	41.75 \pm 18.95	49.5 ^b	9; 62	9; 62
Ashworth Scale (n = 18)	<i>Shoulder</i>	0.67 \pm 0.77	0.5	0; 2	0.37 \pm 0.6	0	0; 2	0.16 \pm 0.37	0	0; 1	0.25 \pm 0.77	0	0; 1	0; 1
	<i>Elbow</i>	1.67 \pm 0.91	1.5	0; 3	1.79 \pm 0.98	2	0; 3	1.26 \pm 0.93	1 ^b	0; 3	1.44 \pm 1.03	1 ^b	0; 3	0; 3
	<i>Wrist</i>	0.89 \pm 1.02	1	0; 4	1 \pm 1	1	0; 4	0.68 \pm 0.67	1	0; 2	0.63 \pm 0.62	1	0; 2	0; 2

Results:

❑ FM: Significant **Improvement** in upper limb:

- Baseline 33
- 4 weeks 49
- one month of follow up 49.5

❑ All subjects showed **excellent compliance** and remarkable satisfaction

❑ No **dropouts** associated to intolerance to treatment

❑ Motor learning maintained 1 month after, indicated that patients were not in a spontaneous recovery stage

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Clinical Trial of ReoGo for the Rehabilitation of Post-Stroke Hemiplegia- exploratory study

K. Takahashi, K. Domen, K. Hachisuka, T. Sakamoto, M. Toshima, Y. Otaka, M. Seto, K. Itie, B. Haga, T. Takebayashi, T. Kimura

Japan

AHA, International Stroke Conference (ISC2011),LA,2011

Objective:

- ☐ To examine whether **robotic therapy** in addition to standard UE training **improves** UE function more than **self-training** in addition to standard training.

- ☐ To examine which **severity level** of hemiplegia could benefit from the robotic therapy

Design:

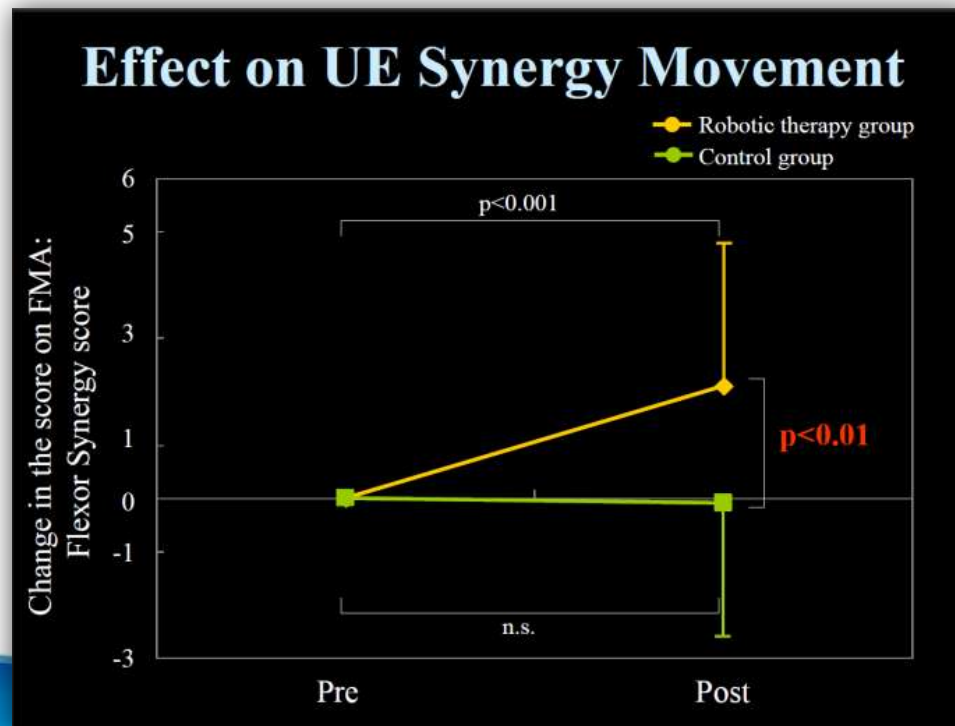
- ☐ Prospective, single-blinded, randomized, multicenter
- ☐ 6 rehabilitation facilities
- ☐ 60 patients (41 men, 19 women; mean age, 64.8 ± 10.8 years)
- ☐ Sub-acute post-stroke Hemiplegia (UE Brunnstrom stage III to IV) experienced stroke in the previous 4 to 8 weeks

Treatment protocol:

- ☐ In addition to daily therapy sessions
- ☐ 40 min of ReoGo therapy or self-training (control group).
- ☐ 6 weeks (7 days a week)

Results:

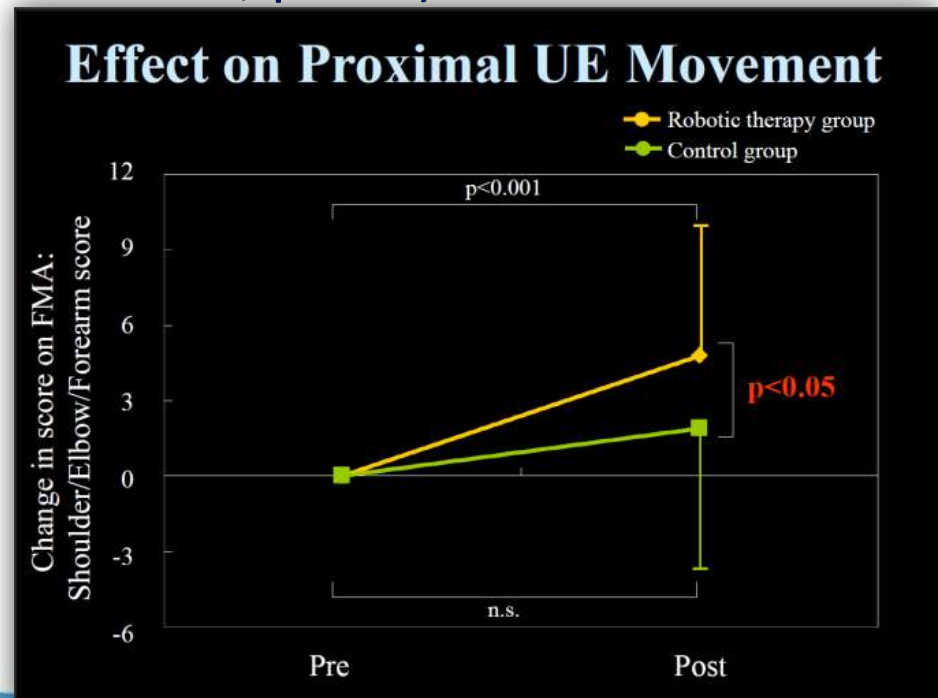
- ❑ Robotic therapy group, as compared to control group
- Significant improvement in the FM Flexor Synergy score (score change 2.1 ± 2.7 vs -0.1 ± 2.4 ; $p < .01$)



Results:

□ Robotic therapy group, as compared to control group

- Shoulder/Elbow/Forearm score
- (score change 4.8 ± 5.0 vs 1.9 ± 5.5 ; $p < .05$).

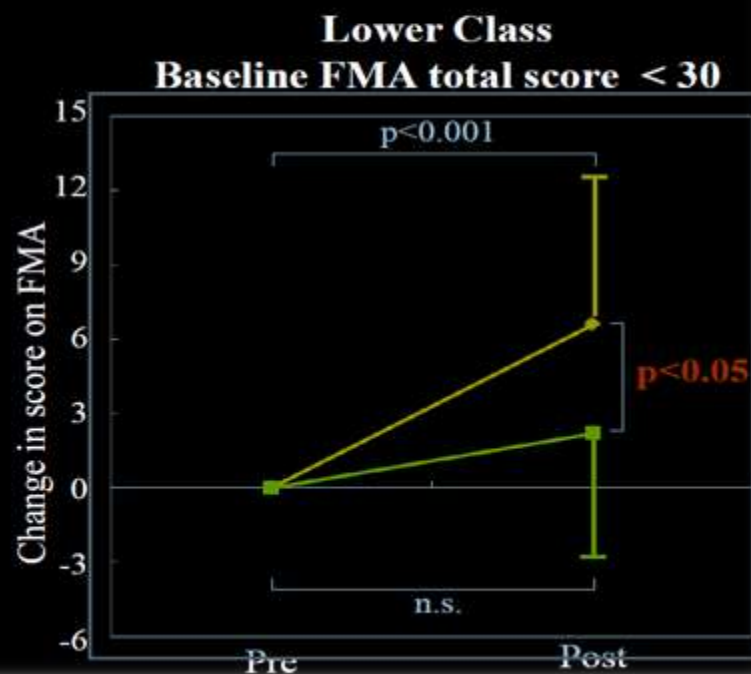
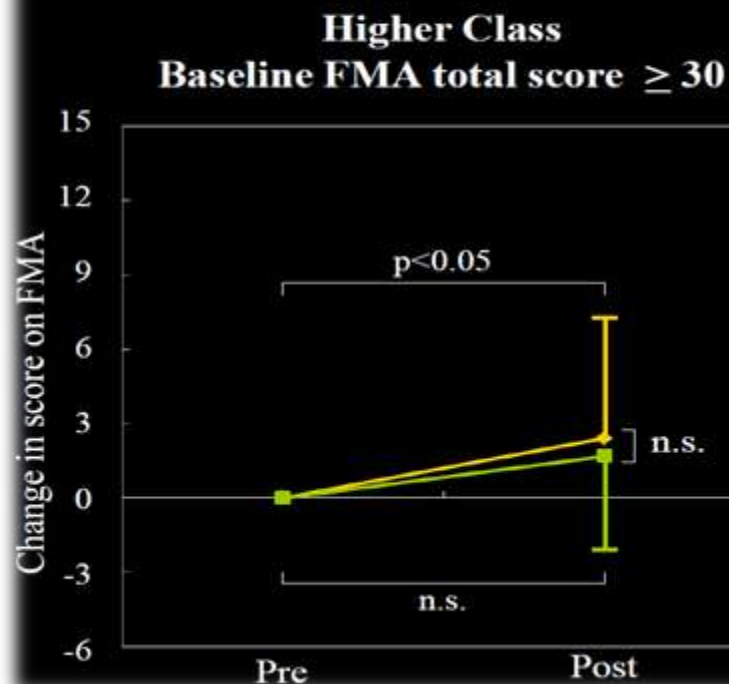


Results:

- ❑ Participants were divided with baseline FM total score into:
higher (>30) or lower (<30) function cohort,.
- In the higher function cohort
no significant difference between two groups.
- In the lower function cohort,
RoGo therapy significantly improved FM Shoulder/Elbow
/Forearm score compared with control group (score
change **6.6** ± 5.1 vs **2.2** ± 6.2; $p < .05$)

Baseline UE Function and FMA Improvement

● Robotic therapy group
● Control group



Conclusions:

- ❑ People with moderately severe hemiplegia benefit from the ReoGo ,robotic therapy
- ❑ ReoGo treatment benefits includes:
 - Repetitive movement
 - Correct movement pattern
 - Constant amount of assistance

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<input type="checkbox"/> New article

- ☐ General conclusions
- ☐ Ongoing studies



Development and Validation of the First Robotic Scale for the Clinical Assessment of Upper Extremity Motor Impairments in Stroke Patients

Omer Einav, Diklah Geva, Doron Yoeli, Marina Kerzhner, Karl-Heinz Mauritz

Topics in Stroke Rehabilitation, November 2011

Objective

- To develop and **validate** the first robotic-based procedure for assessing upper extremity motor impairments in stroke patients, and to test its **discriminative power**.

Design

□ 100 Stroke patients were evaluated before starting treatment by:

- ReoGo scale (9 tasks)
- Fugl-Meyer (FM) motor test
- Wolf Motor Function Test (WMFT)
- Action Research Arm Test (ARAT).

Results

- ❑ The total ReoGo score correlated closely with the upper extremity scores of the FM, WMFT and ARAT ($r = 0.95, 0.93$ and 0.90 , respectively).
- ❑ The ReoGo score was able to discriminate between low, moderate, and high functioning patients (86% agreement $K = 0.79$, with FM).

Conclusions

- ❑ The **validity** of the Reo Scale Assessment is comparable with that of the FM, WMFT, and ARAT.
- ❑ The objective measuring and scoring of the ReoGo make it an **efficient tool for assessing** motor function of stroke patients in clinical and research settings.

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- ❑ ReoGo treatment is **safe** with no side effects
- ❑ ReoGo Therapy is appropriate for **a wide range of post-stroke** populations (sub-acute and chronic)
- ❑ Significant functionality improvements maintained overtime
- ❑ Patient compliance and satisfaction are **excellent**
- ❑ Remarkable recovery of UE mobility in **severe hemiplegia**

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- ☐ General conclusions
- ☐ Case study & Ongoing studies



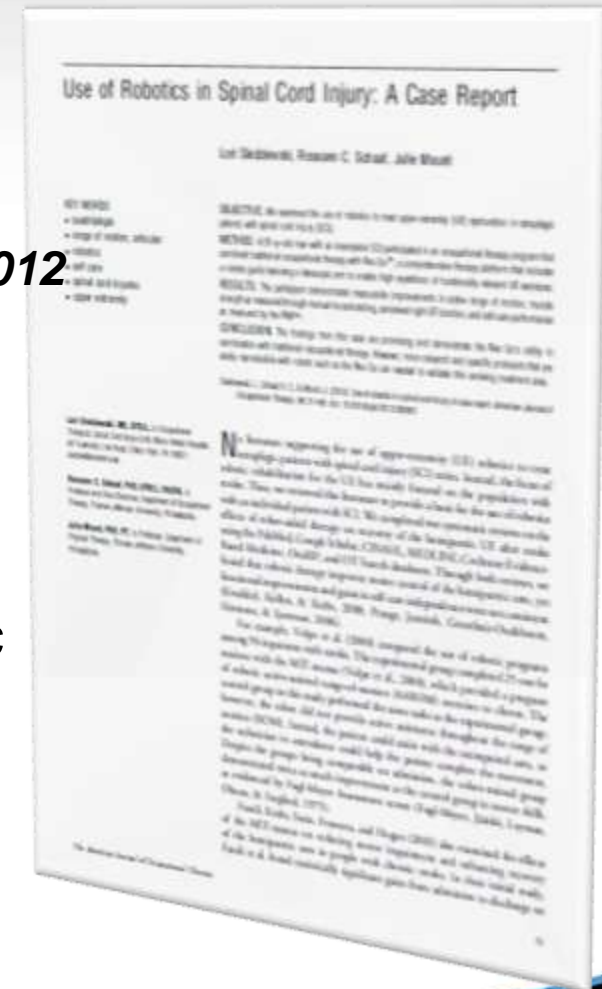
Use of Robotics in Spinal Cord Injury: A Case Report

Lori Sledziewski, Roseann C. Schaaf, Julie Mount

The American Journal of Occupational Therapy, Feb. 2012

Objective

to examine the use of robotics to treat upper extremity (UE) dysfunction in tetraplegic patients with spinal cord injury (SCI).



Method.

A 51-yr-old man with an incomplete SCI received combined traditional occupational therapy with ReoGo, 28 days post injury.

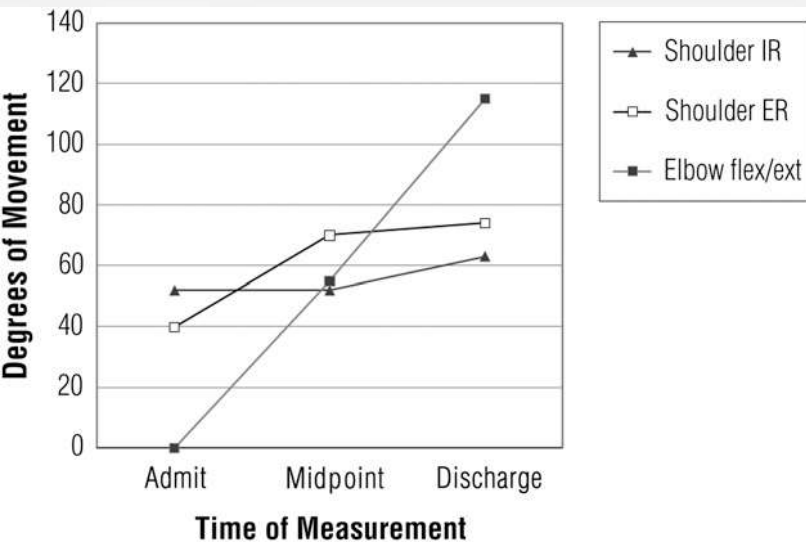
The ReoGo treatment includes:

18 consecutive 1 hour sessions

3 sets of 10 repetitions for each of the following exercises:

- (1) Forward reach, (2) Forward thrust, (3) Horizontal reach,
- (4) Hand to mouth

Results



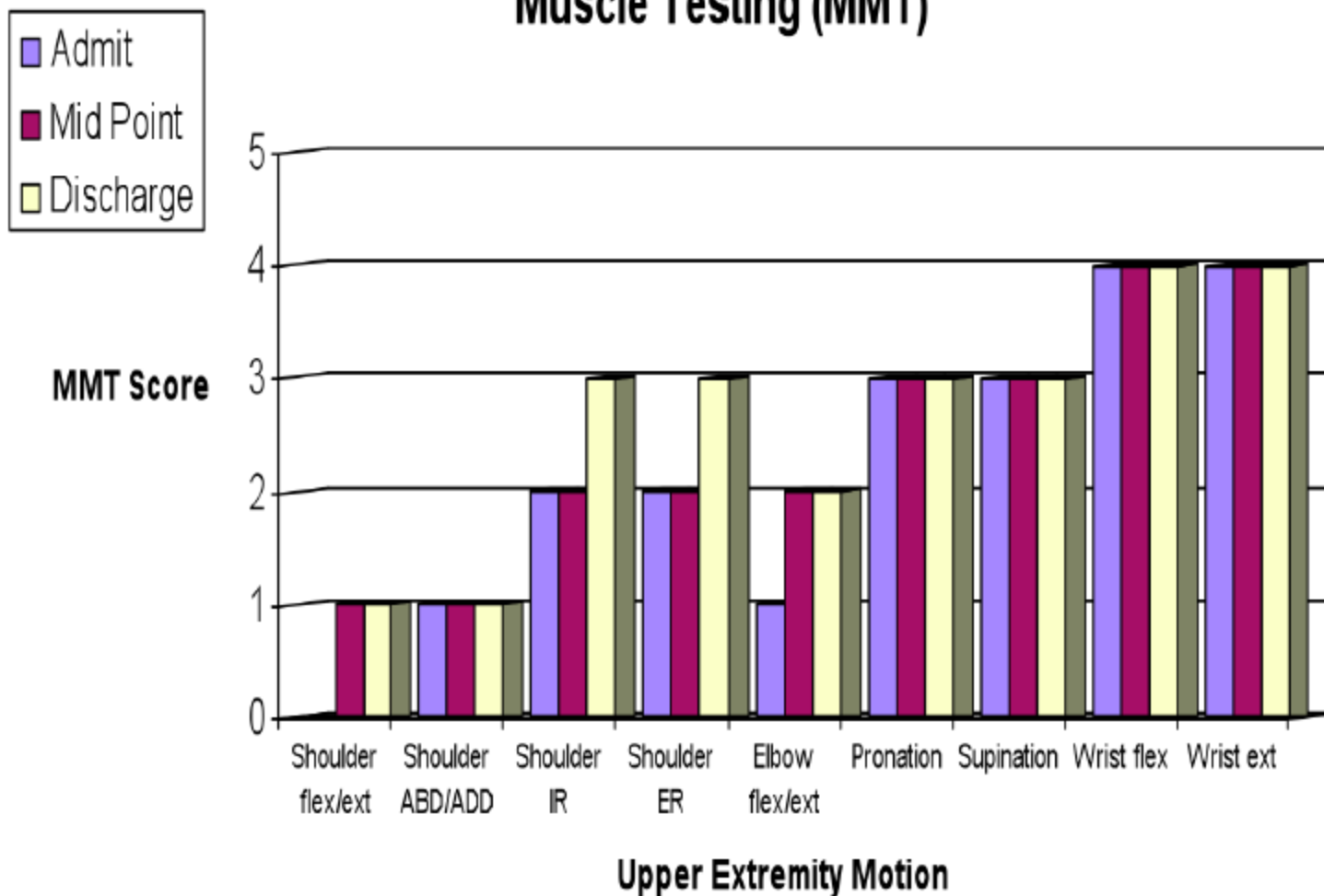
M.R. demonstrated improvements on all outcome measures.

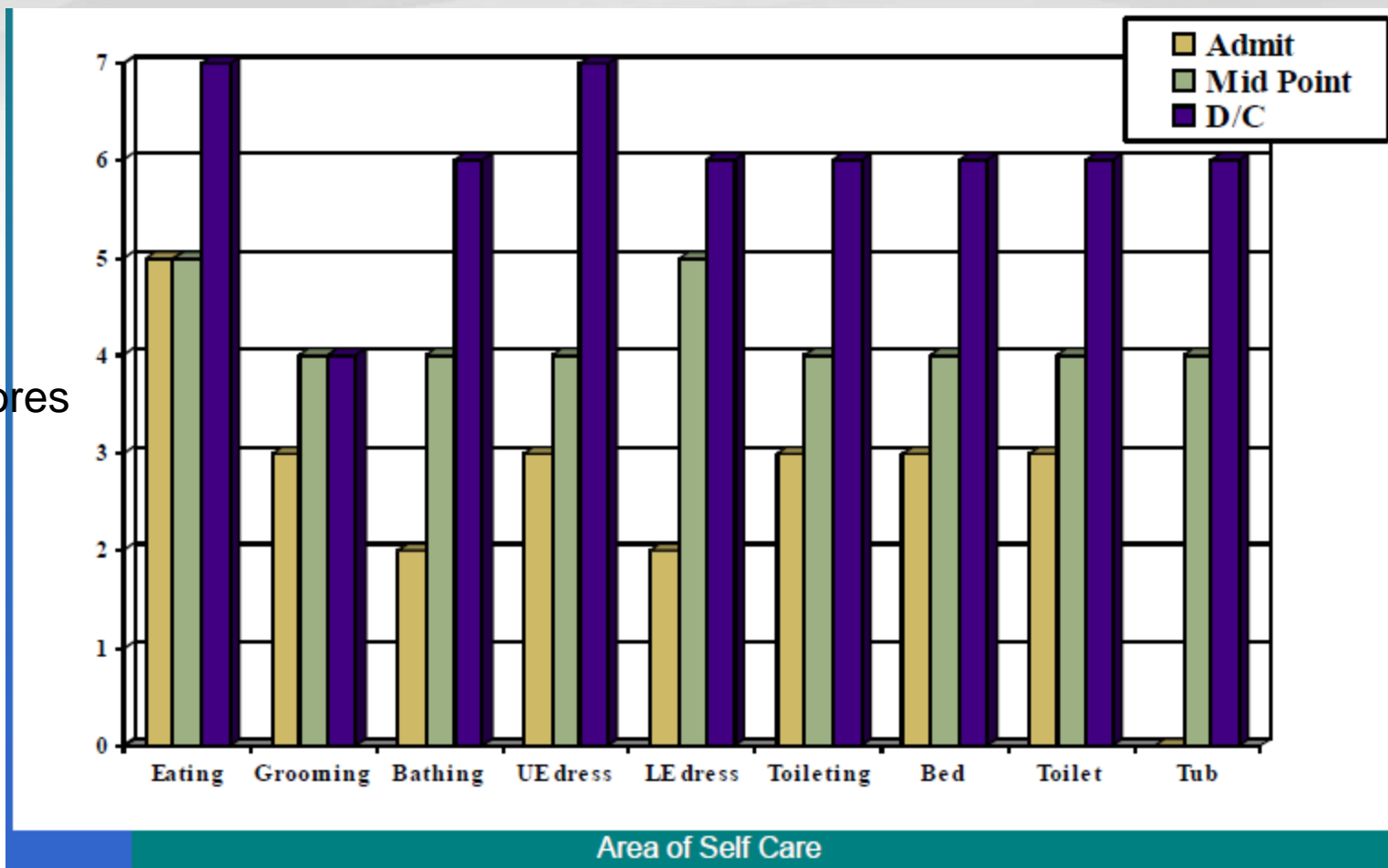
- (1) Increase in AROM
- (2) Increased independence in self-care (FIM score)
- (3) Increase in strength (MMT score)
- (4) Increase in perceived right UE function (CUE score)

Conclusion:

The findings demonstrate the ReoGo's utility in combination with traditional occupational therapy.

Changes in Right Upper Extremity Strength Using Manual Muscle Testing (MMT)





- **Germany , Neils Birbaumer**

- ☐ Combined treatment of **ReoGo and BCI - EEG**

21 stroke patients (40)

Daily training sessions of 45 min. for 4 weeks

- ☐ Results - Training effect was greatest with the ReoGo compared to the hand orthosis (control)

- ☐ ReoGo was very well accepted and tolerated by all patients.

- **Italy, 2011**

- F. Bovolenta – article to be published

- Franco Molteni - **ReoGo and EMG**

- ❖ One case study , chronic stroke patient

Using surface dynamic electromyography during Upper-extremity robotic training

F. MOLTENI, M. CAIMMI, A. CAZZANIGA, G. GASPERINI,
E. GIANDOMENICO, C. GIOVANZANA

Europa Medicophysica , 2008

Design

- 5 Sub acute stroke patients
- 2 weeks therapy – 10 sessions
- 30 min of ReoGo reaching exercises in the following modes:
 - Guided
 - Initiated
 - Step initiated
- The EMG pattern of the arm and shoulder muscles was recorded

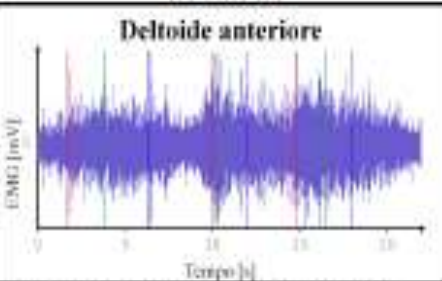
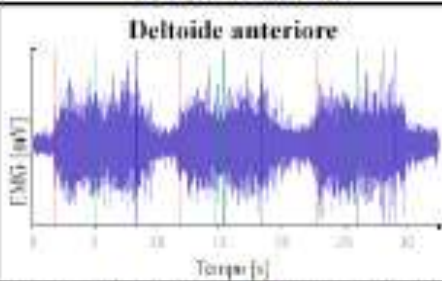
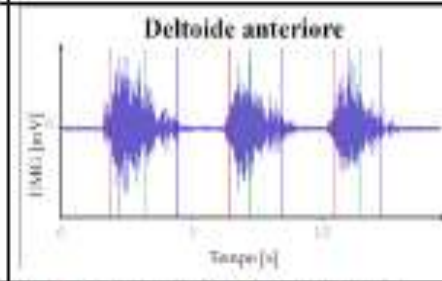
Results

In general in this preliminary study the pattern of activity of the arm and shoulder muscles has improved

Conclusion

The dynamic EMG could be useful for monitoring the patient's muscular activity during robotic treatment

Muscle activity patterns correlates with ReoGo treatment

Activation pattern before ReoGo Treatment	Activation pattern after 1 month of ReoGo Treatment	Normal pattern in healthy person
<p>Deltoide anteriore</p>  <p>There is a continuous activation of the muscle also during resting activity in the chronic post-stroke patient</p>	<p>Deltoide anteriore</p>  <p>After treatment there is visible reduction of the muscle tone during the off periods</p>	<p>Deltoide anteriore</p>  <p>On-off activity of the muscle during reaching and hand-to-mouth phases can be clearly seen in the figure above.</p>

After 1 month of treatment, the patient has improved the motion control (as presented in the table above): the on-off pattern is more similar to the normal one (there are clear activation and rest periods). The improvement is evident.

- **USA – at least 3 more studies**
 - ❑ Kessler Institute for Rehabilitation, USA
 - ❑ NY Presbyterian Hospital, affiliated to Columbia University, USA
 - ❑ National Institute of Neurological Disorders and Stroke, USA

New Clinical Study, 2011

reo Getting people
back on their feet
Ambulator



New Clinical Study, 2011

reO Getting people
back on their feet
Ambulator



Robot-Assisted Gait Training for Patients with Hemiparesis Due to Stroke

Stanley Fisher, Leah Lucas, T. Adam Thrasher

Topics in Stroke Rehabilitation ,May-June 2011

USA , 2011



Objective

To compare the outcomes of robot-assisted gait training (RAGT) using ReoAmbulator with a traditional therapy program

Design

- ☐ 20 Stroke patients (two groups of 10)
- ☐ Control group: 1-hour sessions of conventional therapy
- ☐ RAGT group: 30 min. of conventional therapy and 30 min. of ReoAmbulator
- ☐ 24 sessions

Outcome measures

- ☐ 8-meters walk test
- ☐ 3-minute walk test
- ☐ Tinetti balance assessment

Results

- ☐ Stroke patients improved walking function following ReoAmbulator therapy
- ☐ The functional gains of the robotic therapy **were not significantly better** than conventional physical therapy.

Conclusion

ReoAmbulator and conventional physical therapy, **as applied** in this study,* may produce **similar clinical** outcomes.

The added value of the ReoAmbulator treatment

- Physical therapy required **significantly more therapist time** (12 additional therapist-hours per patient) than the RAGT.
- ReoAmbulator therapy can provide a **controlled, consistent** level of therapy in many different settings.

*Please note that the duration of the robotic therapy in this study was only 30 min

Therapy with a robotic touch



Thank You



www.motorika.com