JAHRESTAGUNG DER Ö. WACHKOMA GESELLSCHAFT
in Kooperation mit der Ö. Gesellschaft für Neurorehabiliation

„WACHKOMA UND IMMOBILITÄT
– Lasst mich bloß in Ruhe!“

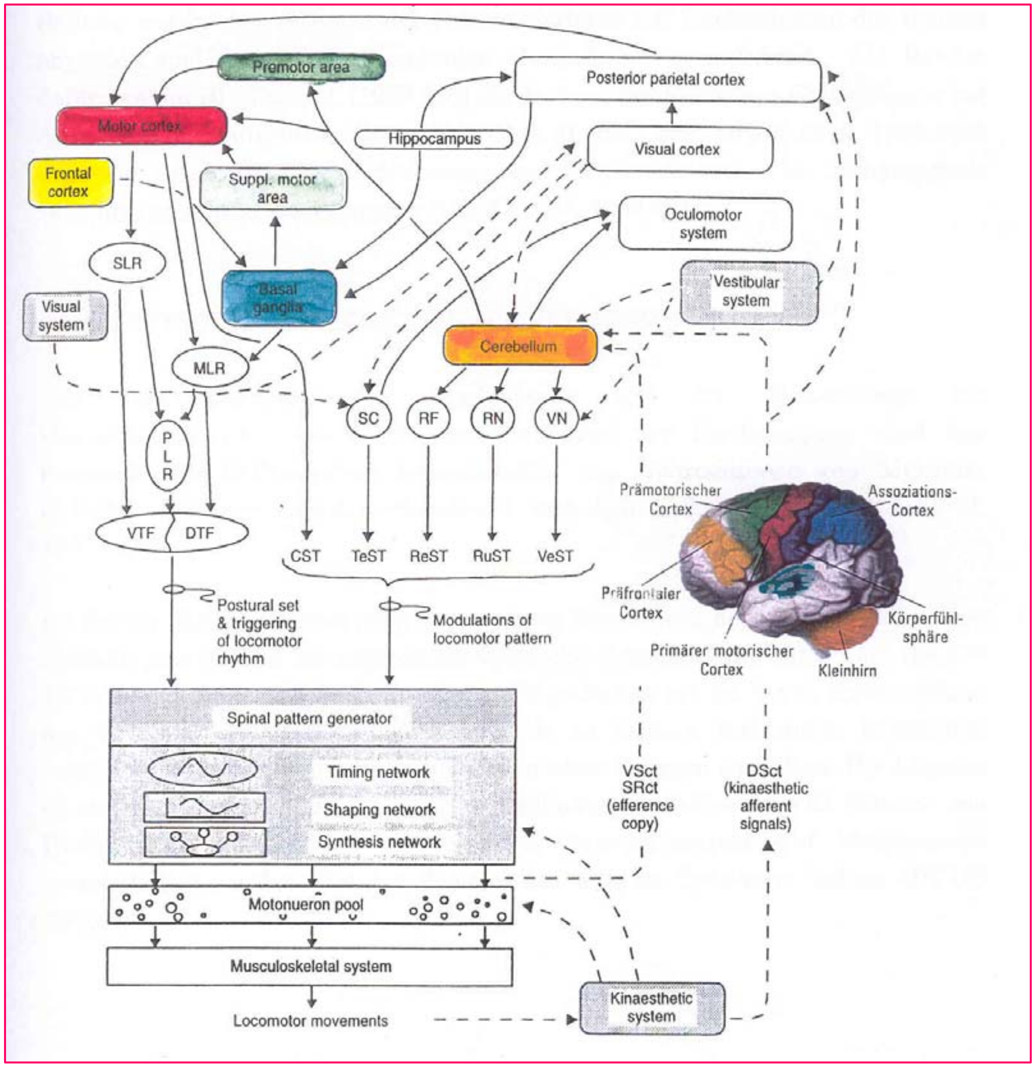
„Robotics – sich gehen fühlen“

L. Saltuari

Locomotion

- Locomotion is a complex structurised function which is organised in a hierarchy, starting from the spinal level and controlled by brain stem, extrapyramidal and cortical structures
- This complex motor control is also expressed in the development of gait in children

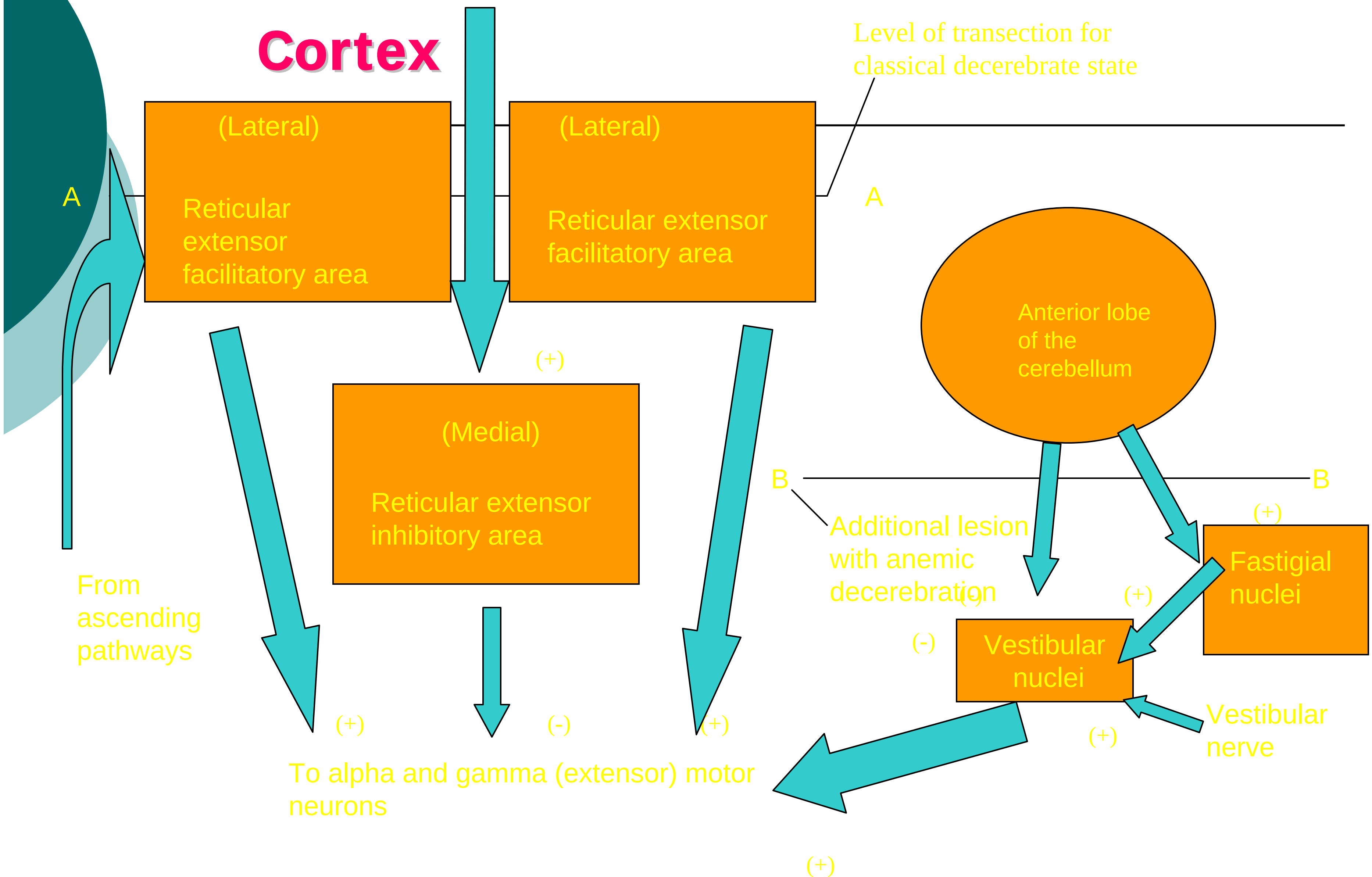
Control System for Locomotion



The Hierarchy of Motor Control

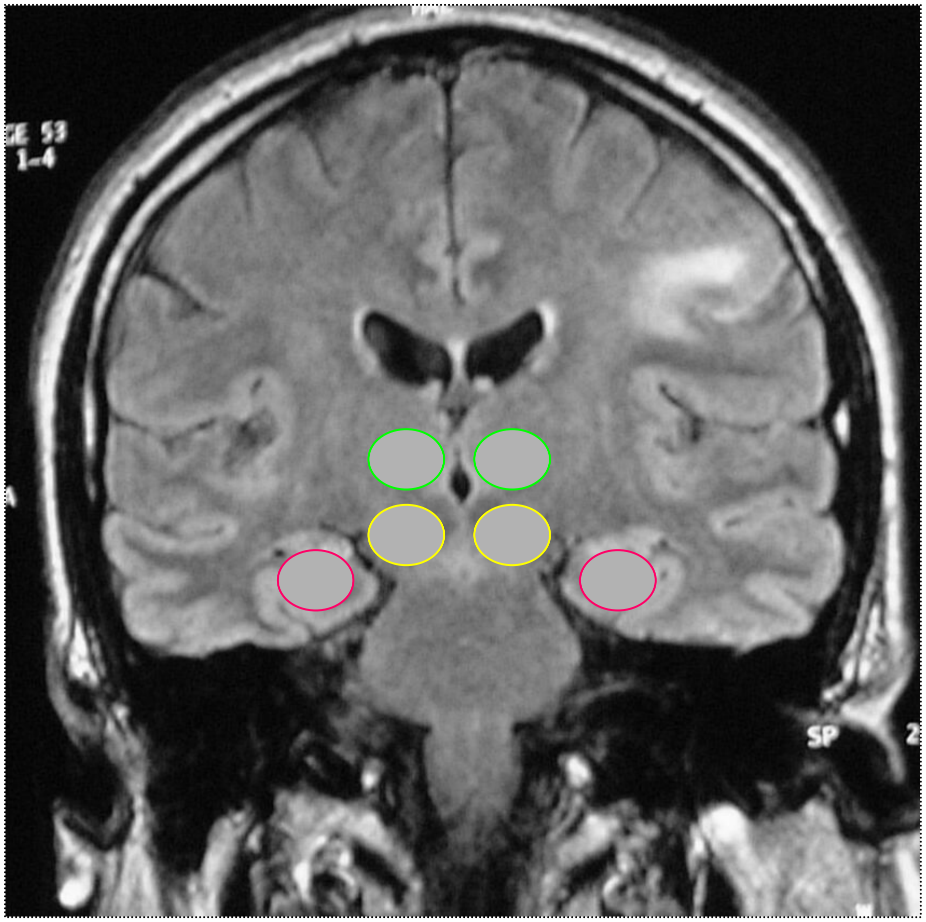
- Local spinal cord reflexes triggered by myotactic stretch receptors localized to the point of stimulus, are highly stereotyped, and have an onset time of 35 – 40 msecs.
- Automatic brain stem and subcortical reflexes coordinated among the leg and trunk muscles, stereotyped but adaptable, and coordinate movements across joints. Onset time ist 85 – 95 msecs.
- Voluntary responses that generate purposeful behaviors and have longer onset itme latencies of 150+ msecs, sometimes called proactive balance control systems. Vision and attention are the keys to the early detection of potential balance threats.

Supraspinal Control



Higher „motive“ centers

- Substantia Nigra
  - To the Mesencephalic locomotor region
- Ventral Pallidum (aka Internal Globus Pallidus)
  - To Substantia Nigra
- Nucleus Accumbens (NA)
  - Projects to Ventral Pallidum
- Hippocampus
  - Projects to NA



Cerebellum

•Vermal and paravermal regions (and associated nuclei are involved)

-Hemispheres contribute minimally

•Influences locomotion indirectly

•Red nucleus

-Swing phase

•Lateral vestibular (Dieter's) nucleus

-Stance phase

•Medial Medullary reticular formation

-Coordination of gait

-Through ventral spinocerebellar tract

„Upper motor neuron Syndrome“

- Muskular weakness
- spasticity
- hyperreflexia
- irradiation of reflexes
- synergisms
- primitive motor patterns
- pyramidal signs

Scientific evidence in Neurorehabilitation

- Repetition
- Constrained-induced Therapy
- Endurance

Functional magnetic resonance imaging before motor cortex stimulation for phantom limb pain

Nervenarzt. 2007 Sep 12

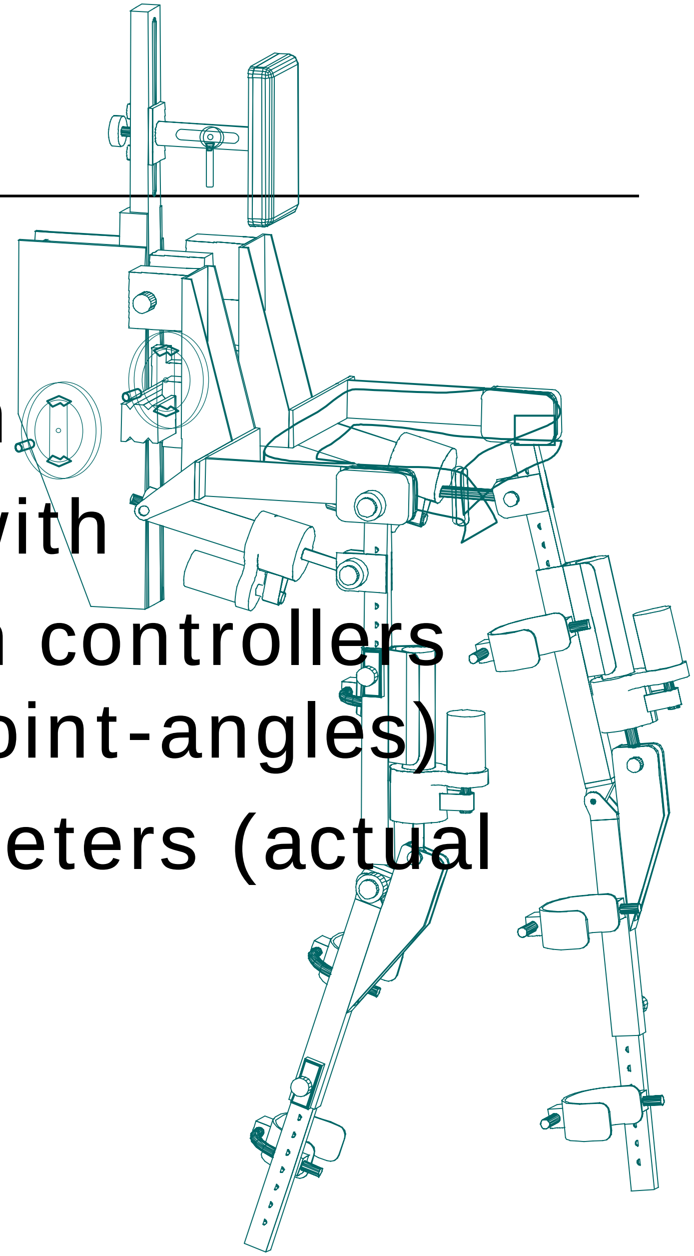
Koppelstaetter F, **Siedentopf CM**, **Rhomberg P**, **Lechner-Steinleitner S**, **Mottaghy FM**, **Eisner W**, **Golaszewski SM**.

Univ.-Klinik für für Radiologie II, Medizinische Universität, Innsbruck, Österreich.

This study deals with the diagnostic value of functional magnetic resonance imaging (fMRI) in a patient with phantom limb pain following traumatic amputation of the right arm. After failure with medication, resection of stump neurinoma, and spinal cord stimulation, fMRI with evidence of cortical reorganization was performed. Tactile stimulation of the perioral region and motor imagery with cranial, tactile stimulation of the stump led to a caudal shift in fMRI activity. Subsequent motor cortex stimulation brought relief from the pain. By detecting cortical reorganization, fMRI contributes to the indication for motor cortex stimulation for phantom pain and aids in electrode positioning.

Errigo

Lokomat



- ParaCare – Balgrist Zürich
- Automated gait orthesis with
  4 independent PD position controllers (reference hip and knee joint-angles)
  and 8 precision potentiometers (actual joint-angles)

Lokomat

Evaluation of Efficacy of Lokomat Training in Comparison to Conventional Physical Therapy

- Randomized
- Prospective
- Double blind
- U-Test and Wilcoxon-Test

Table 1. Demographic Patient Data

Patients	Sex, Male/Female	Age, Years	Onset, Months	Additional Symptoms	Group Allocation	Lesion on CCT	Etiology
1	F	66	1	Aphasia	1	L MCA	Ischemia
2	F	63	2.5	R Hemianopia R Hemineglect	1	L BASAL	Hemorrhage
3	F	65	2		1	L MCA	Ischemia
4	F	42	3		2	R MCA	Ischemia
5	F	26	3	Aphasia	2	L MCA	Ischemia
6	F	75	0.5		2	R MCA	Ischemia
7	F	57	1		2	R MCA	Ischemia
8	F	78	1		2	R MCA	Ischemia
9	M	44	10		1	L MCA	Hemorrhage
10	F	78	5		2	L MCA	Ischemia
11	M	64	8	L Hemianopia Aphasia	1	L MCA	Ischemia
12	M	71	1.5		1	L BASAL	Hemorrhage
13	M	67	1.5		2	R BASAL	Ischemia
14	M	65	2		1	R BASAL	Ischemia
15	M	67	1.5	L Hemianopia L Hemineglect	2	R MCA	Ischemia
16	F	87	1		1	R MCA	Ischemia
N = 16	Male = 6 Female = 10	63.4	2.8			R = 8 L = 8	Ischemia = 13 Hemorrhage = 3

R, right; L, left; MCA, territory of the middle cerebral artery; BASAL, basal ganglia; CCT, cerebral computerized tomography.

Methods

- Number of patients: 16
- Sex: 6 male, 10 female
- Age: mean 63.4 years

- Etiology: Stroke
  - cerebral ischemic: 13
  - cerebral hemorrhagic: 3
- Side: 8 right side, 8 left side
- Onset time: 2.8 months

Design

	3 Wochen	3 Wochen	3 Wochen
Gruppe ABA	A Lokomat	B Konvent PT	A Lokomat
Gruppe BAB	B Konvent PT	A Lokomat	B Konvent PT

4 Untersuchung

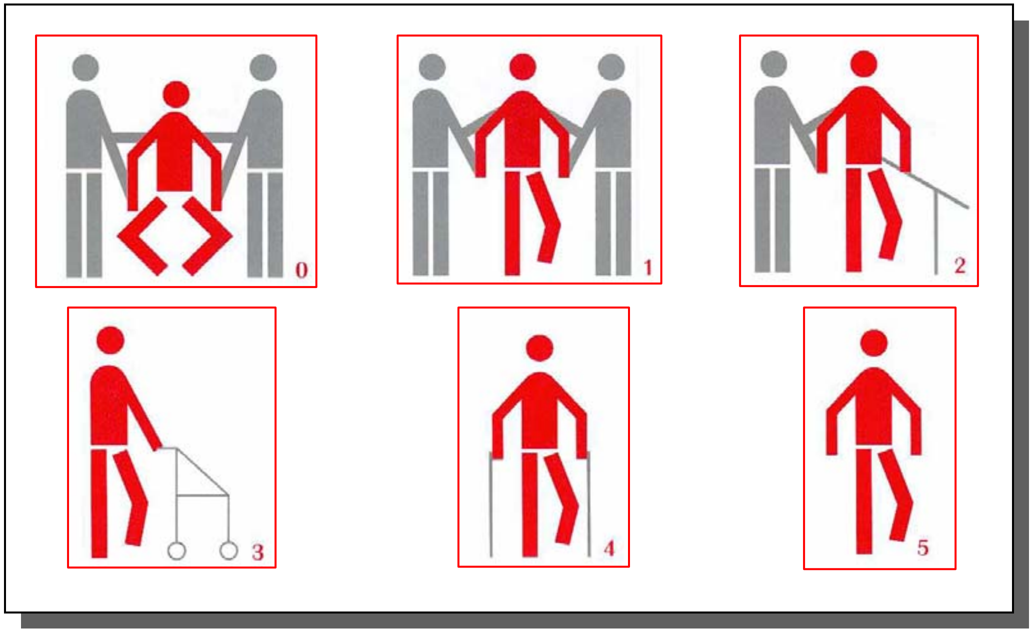
Time Walking Test

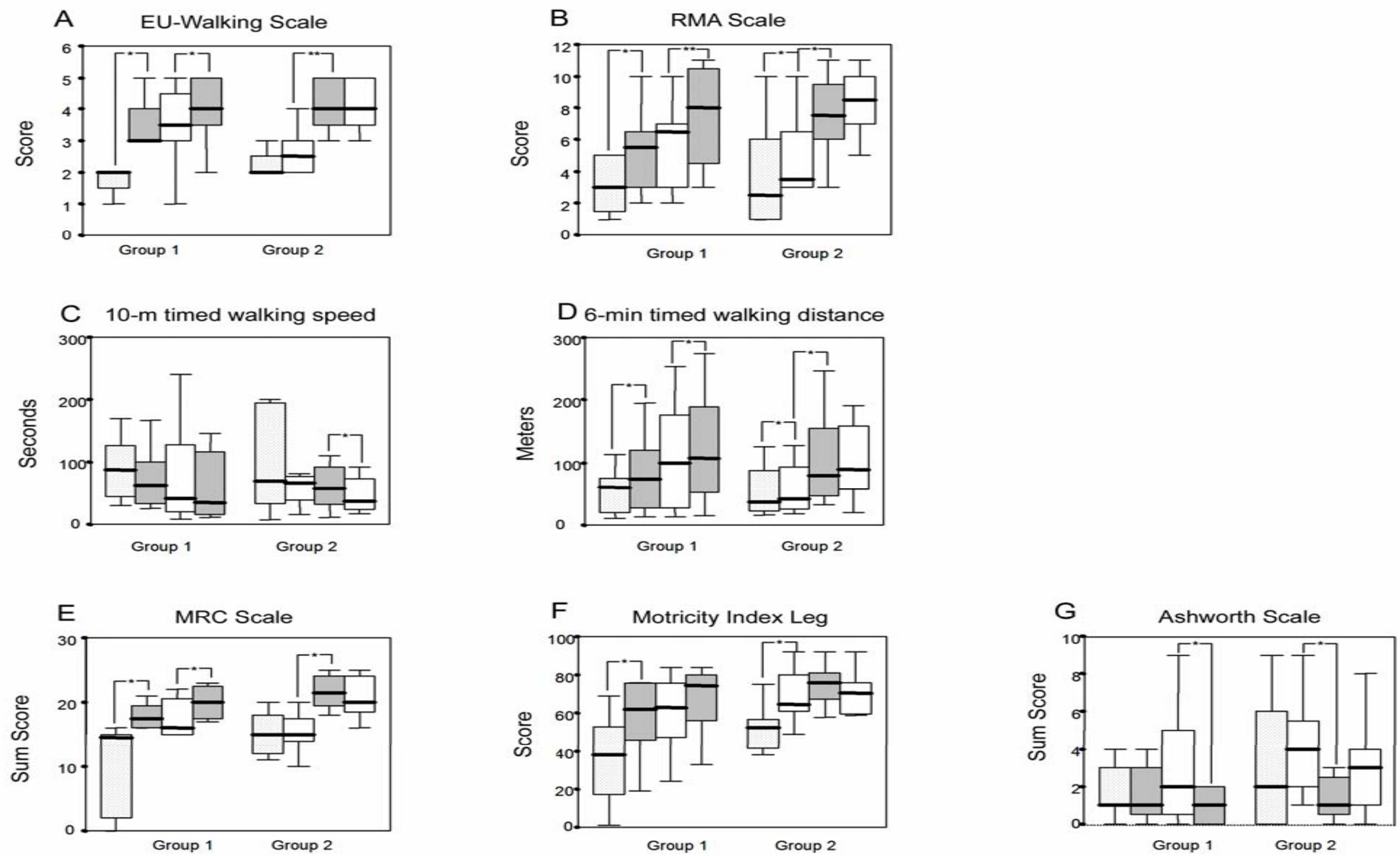
- TWT 10 m
  - Wie lange braucht Patient für 10 Meter
- TWT 6 min
  - Wie weit geht Patient in 6 min

Rivermead Motor Assessment

- Sit unsupported
- Without holding on, on edge of bed, feet unsupported
- Lying to sitting on side of bed
- Using any method
- Sitting to standing
- May use hands to push up. Must stand up in 15 sec and stand for 15 sec, with an aid if necessary
- Transfer from wheelchair to chair towards unaffected side
- May use hands
- Transfer from wheelchair to chair towards affected side
- May use hands
- Walk 10 m indoors with an aid
- Any walking aid. No stand-by help
- Climb stairs independently
- Any method. May use bannister and aid-must be a full flight of stairs
- Walk 10 m indoors without an aid
- No stand-by help. No caliper, splint or walking aid
- Walk 10 m, pick up bean bag from floor, turn and carry back
- Bend down any way, may use aid to walk if necessary. No stand-by help. May use either hand to pick up bean bag.
- Walk outside 40 m
- May use walking aid, caliper or splint. No stand-by help.
- Walk up and down four steps
- Patient may use an aid if he would normally use one, but may not hold on to rail. This is included to test ability to negotiate curb or stairs without a rail
- Run 10 m
- Must be symmetrical
- Hop on affected leg five times on the spot
- Must hop on ball of foot without stopping to regain balance. No help with arms.

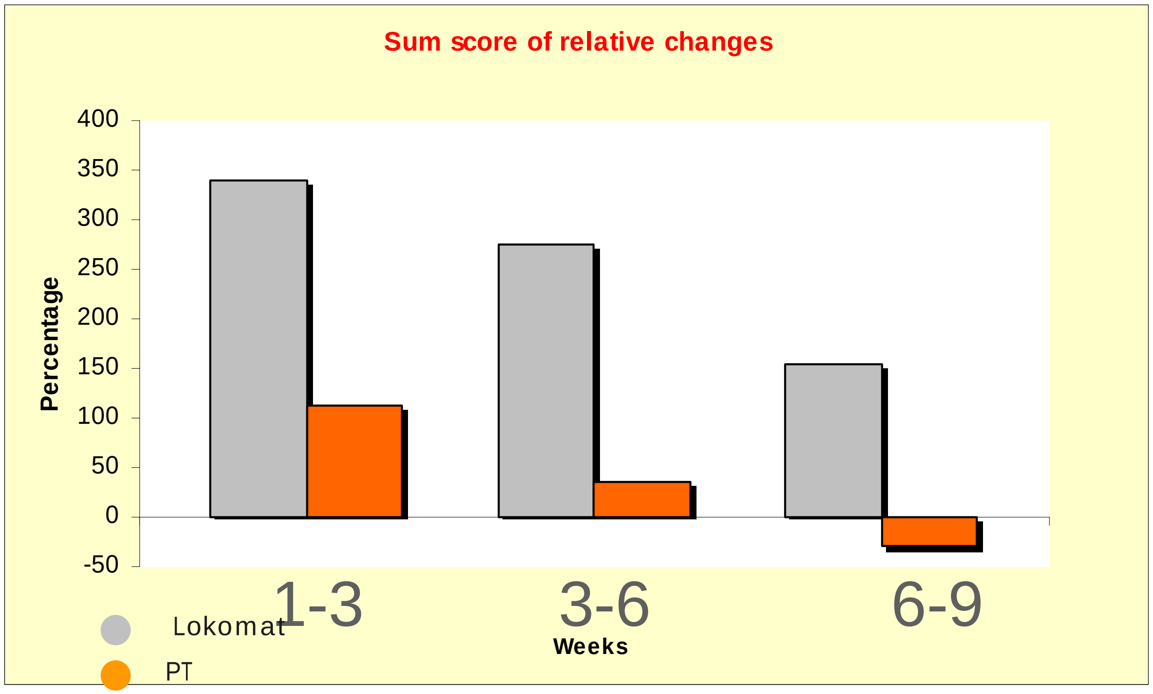
EU-Walking





A
EU-Walking Scale
Score
Group 1
Group 2
B
RMA Scale
Score
Group 1
Group 2
C
10-m timed walking speed
Seconds
Group 1
Group 2
D
6-min timed walking distance
Meters
Group 1
Group 2
E
MRC Scale
Sum Score
Group 1
Group 2
F
Motricity Index Leg
Score
Group 1
Group 2
G
Ashworth Scale
Sum Score
Group 1
Group 2

Figure 2A-G



Prospective blinded randomized crossover study of gait rehabilitation in stroke patients using the Lokomat gait orthosis

Mair, Kofler, Saltuari
Neurorehabilitation and Neural Repair, May 2, 2007

Summary

- Significant improvements in function, strength and reduction of spasticity
- Patients profit more from ABA than BAB
- Patients in low remission phases seem to profit more in improvement of spasticity, functional and nursary outcome
- The wide range of remission phases and clinical pictures with relative low numbers of patients reduce the reliability of the data.

Clinical trial

Landeskrankenhaus Hochzirl
Anna-Dengel-Haus

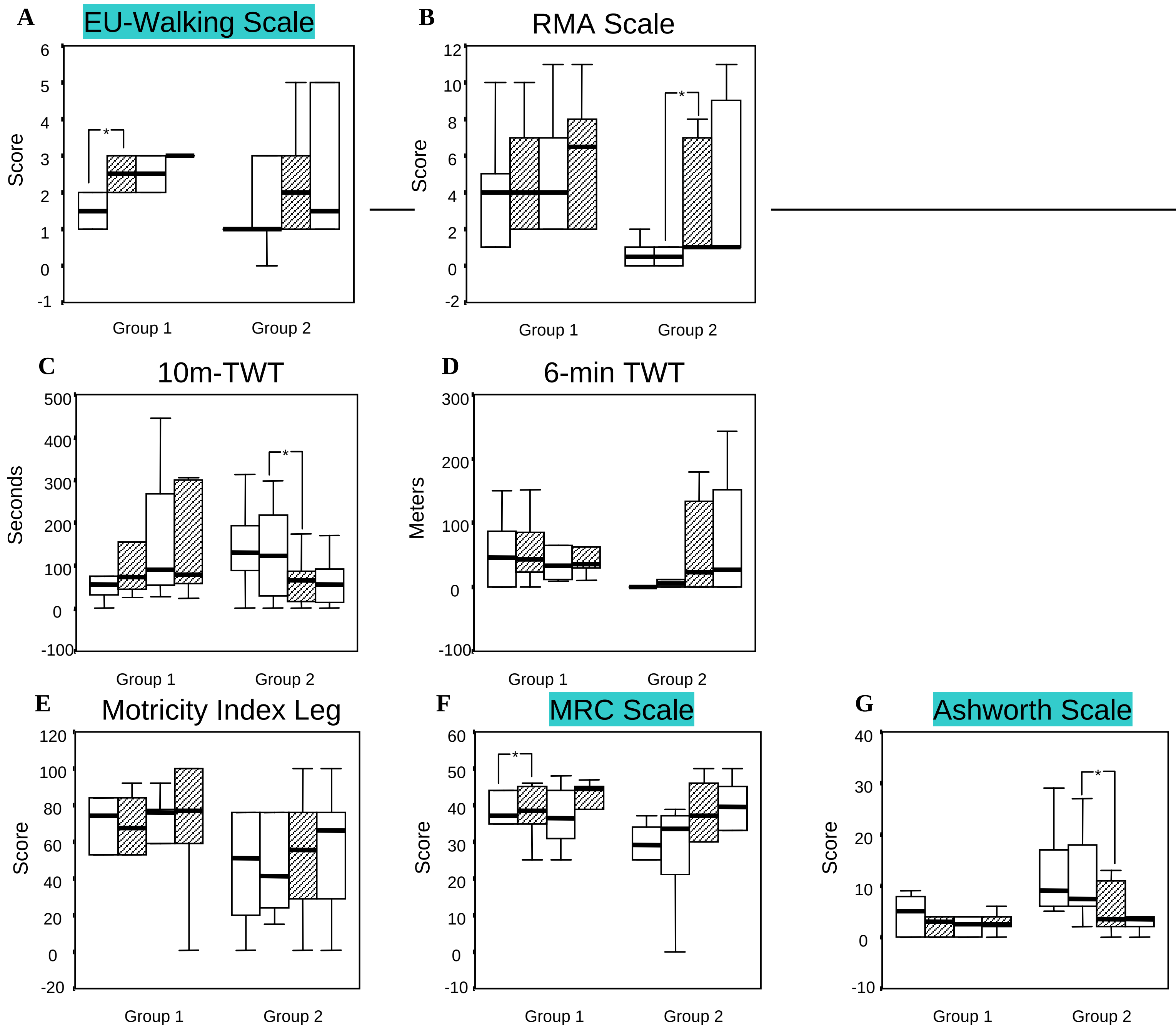

A
EU-Walking Scale
B
RMA Scale
C
10m-TWT
D
6-min TWT
E
Motricity Index Leg
F
MRC Scale
G
Ashworth Scale
Score
Seconds
Meters
Group 1
Group 2
*

Figure 2A-G

Conclusion

- Clinical trials support the utility of Robotics in neurorehabilitation.
- Beneficial effects include reduction of muscle tone, increase of endurance, dexterity and earlier autonomy
- Robotics cannot substitute hands-on therapy, especially in treatment for trunk control, therefore should be used as supplementary therapy

- How complex must engineering of Robotic devices be in oder to be beneficial on an optimal level?