



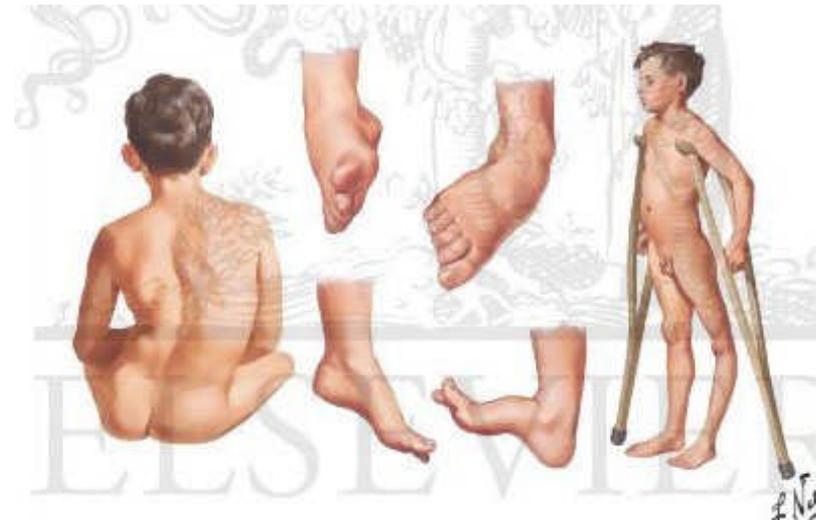
# Physical modalities in the treatment of neurological dysfunction

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# Historical overview

- Poliomyelitis epidemic
  - Muscle re-education
- Central nervous system disorders
  - Compensatory strategies, e.g. bracing



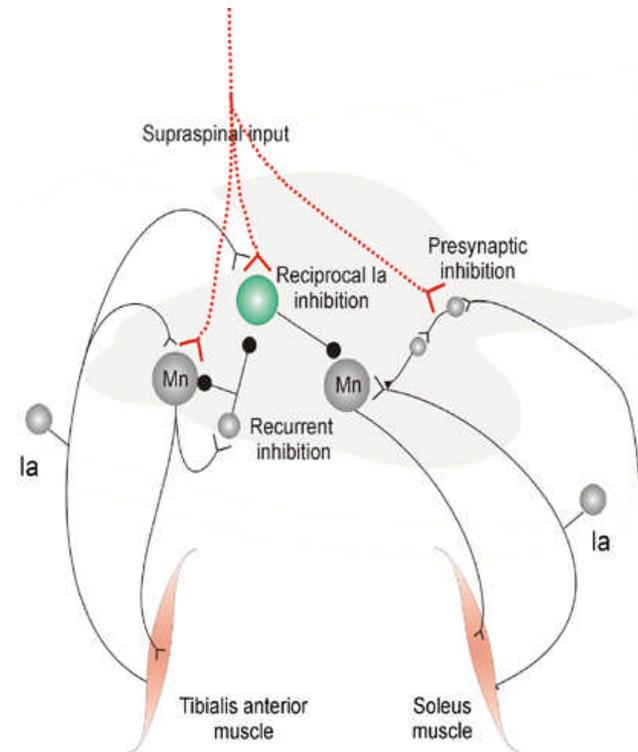
# Upper motoneuron syndrome

## Positive features

- Abnormal reflexes
- Spasticity

## Negative features

- Weakness
- Loss of dexterity



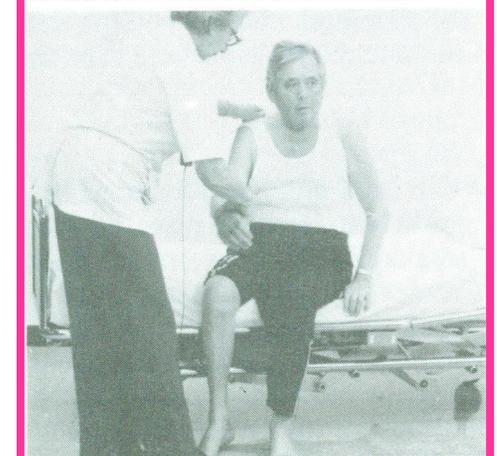
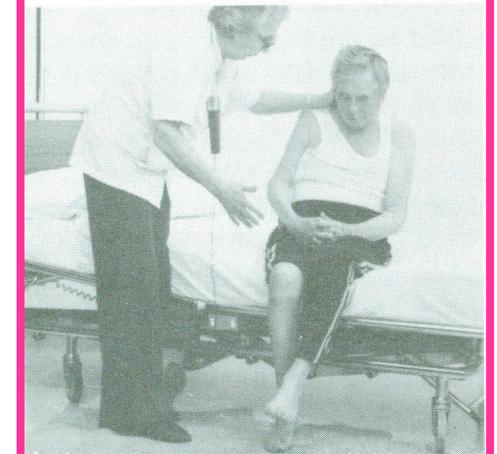
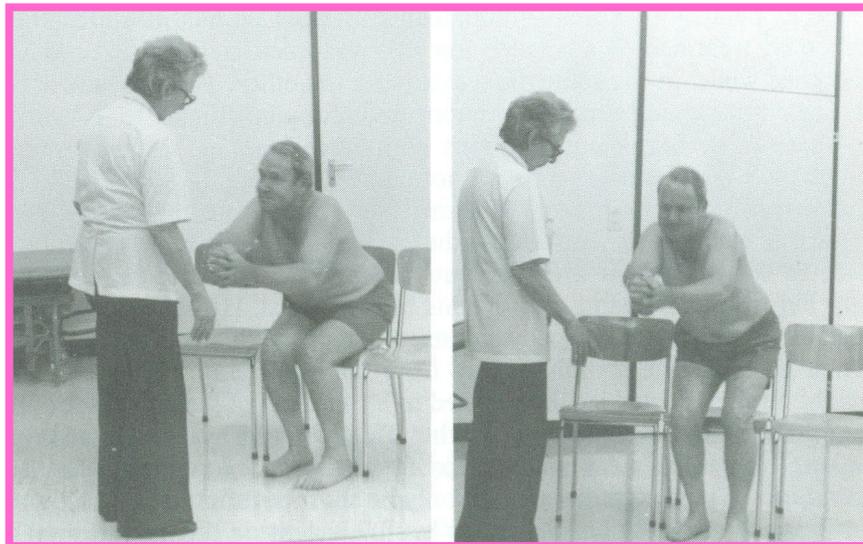
# Neurotherapeutic approaches

- Bobath concept/NDT
- Rood
- Proprioceptive Neuromuscular Facilitation
- Contrast with “orthopaedic approach”

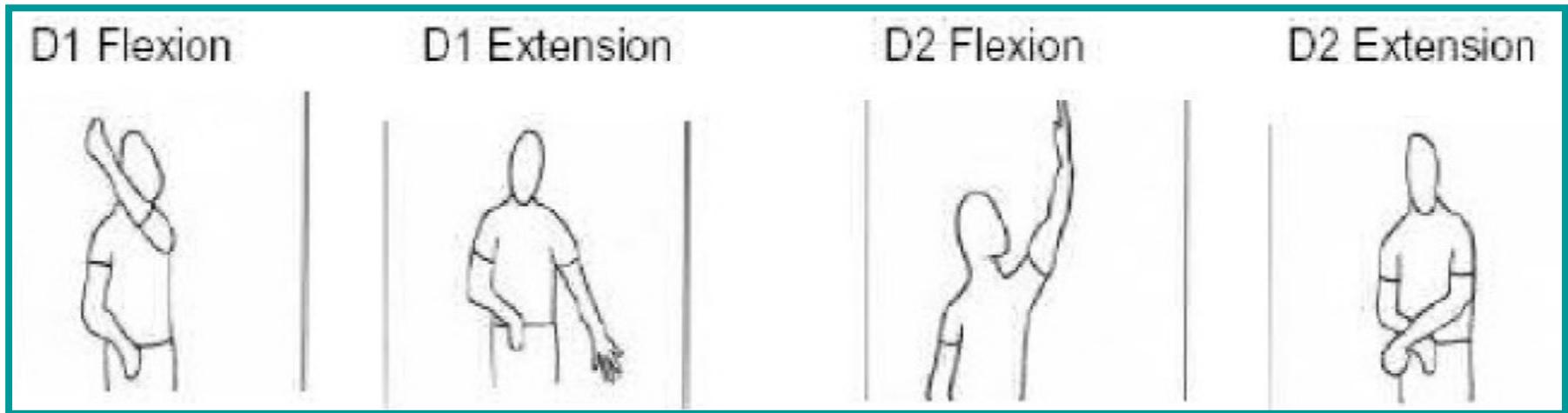
# Bobath concept/NDT

Emphasis on:

- functional tasks, weight - bearing through affected limbs
- Need to inhibit spasticity



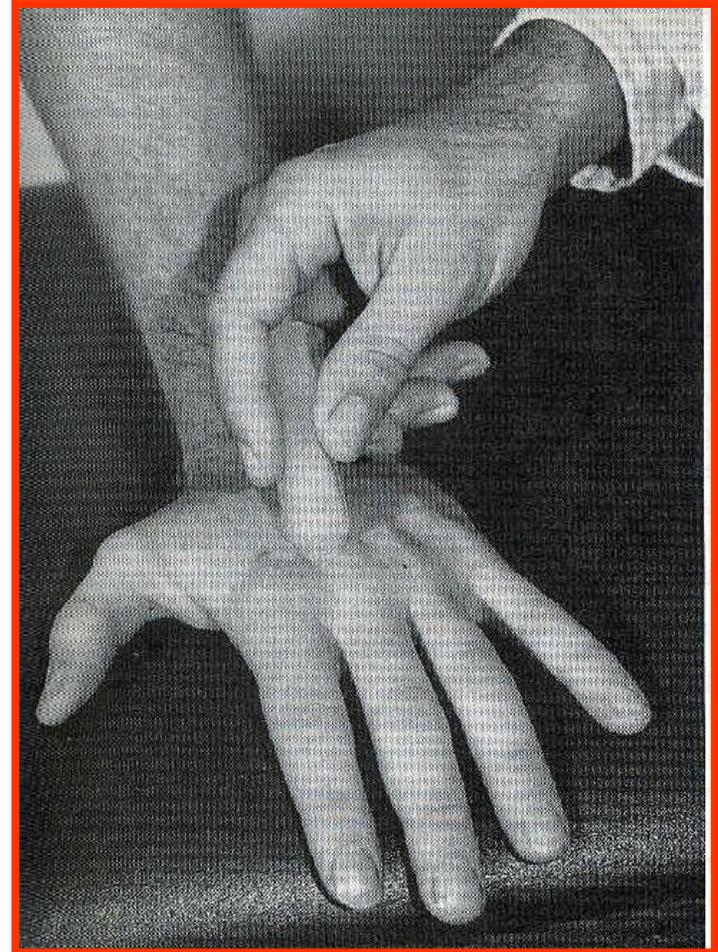
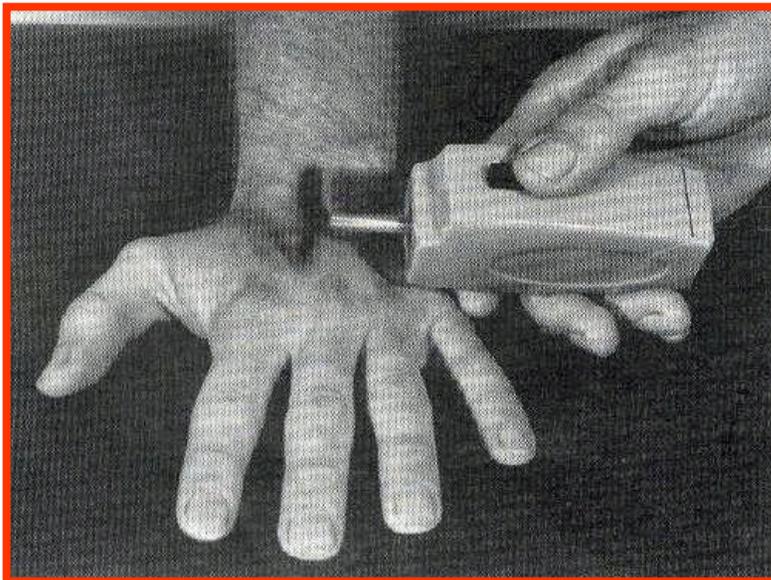
# Proprioceptive Neuromuscular Facilitation (PNF)



- Diagonal, spiral patterns
- Quick stretch
- Resistance

# Margaret Rood

- Therapeutic exercise based on ontogenetic sequence
- Cutaneous stimulation – brushing, icing

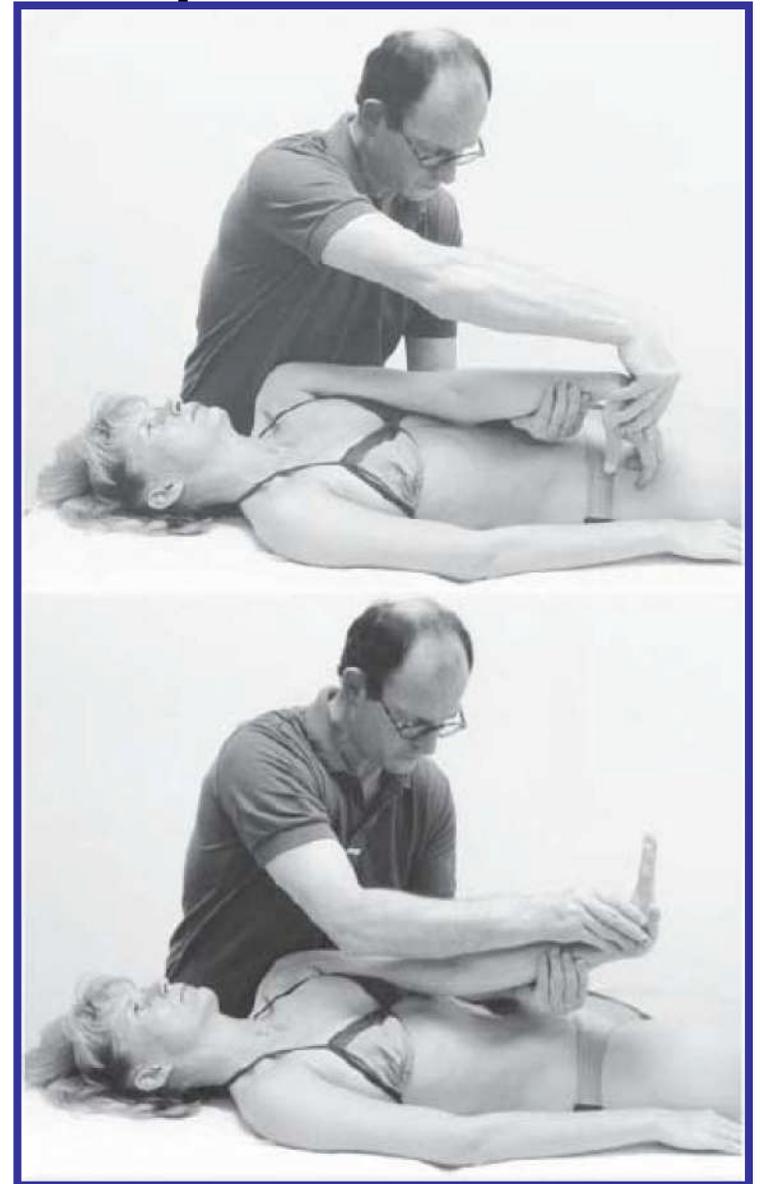


# Facilitation techniques

- Quick stretch
  - enhances force development in a contracting muscle
  - Contraction linearly proportional to level of isometric contraction
- Traction
  - Enhances movement
- Approximation
  - Promotes stability

Cavagna et al. 1968 *J Appl Physiol* 24:21-32;

Webber & Kriellars, 1997 *J Appl Physiol* 83:40-45



# Facilitation techniques

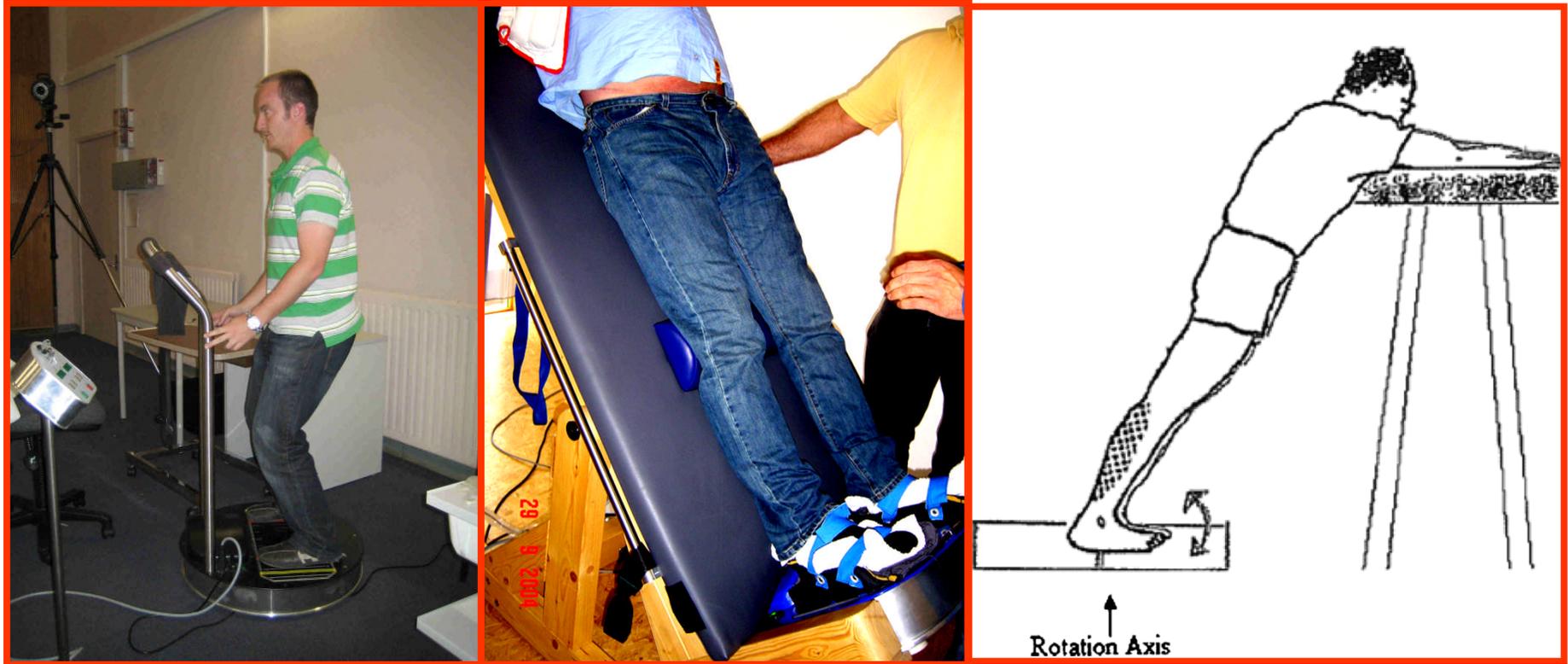
## Brushing

- Immediate facilitatory effect but not sustained

## Quick icing

- Decreases skin temperature by 7°
- Alters excitability of spinal motoneurons

# Whole Body Vibration

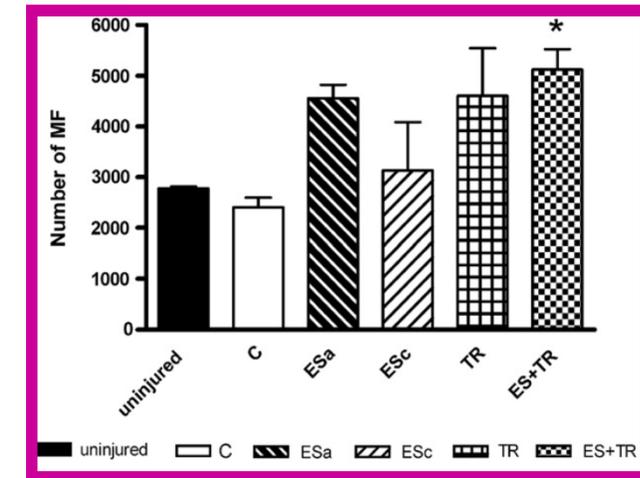
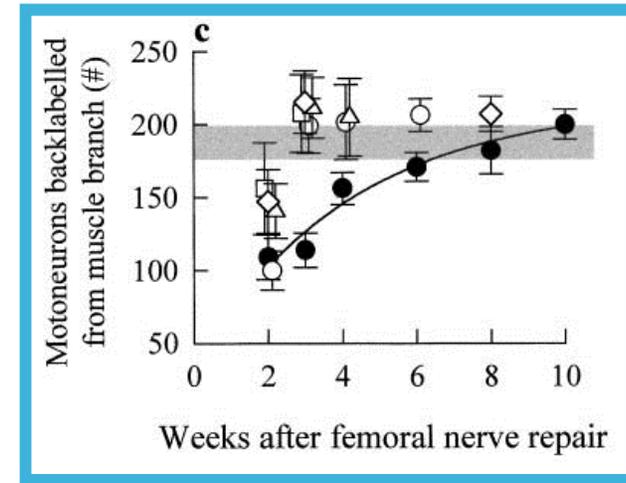
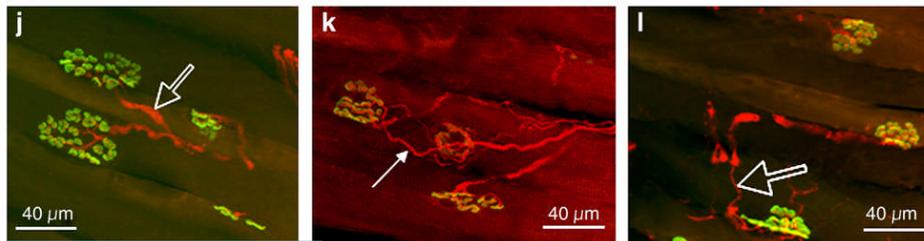
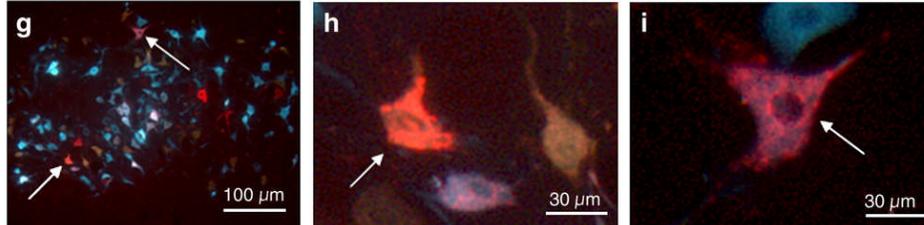
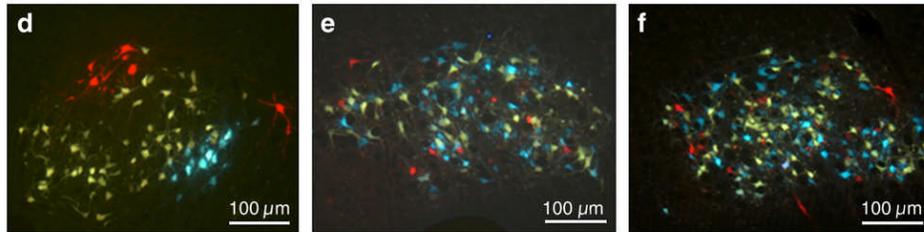
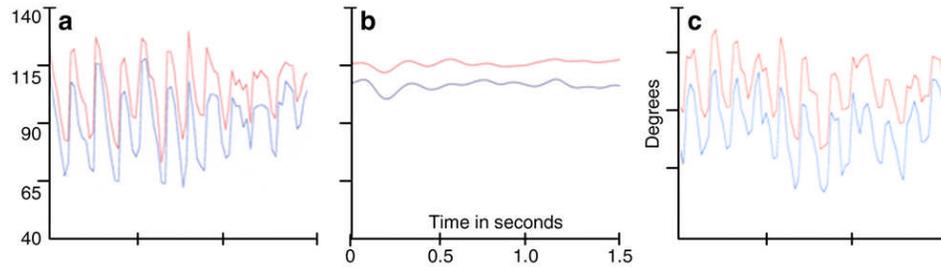


- Improvements in blood flow, muscle strength
- Peak voluntary torque generated at longer muscle length

Lohman et al. 2007 *Med Sci Monit* 13:CR71-CR76 ; McBride et al. 2010 *J Strength Cond Res* 24:184-189;

Kemertzis et al. 2008 *Med Sci Sports Exerc* 40:1977-1983

# Electrical stimulation of peripheral nerve



Angelov et al. *Neurobiol Dis* 2007 26:229–242; Al-Majed et al. *J Neurosci* 2000: 20:2602–2608; Asensio-Pinilla et al. *Exp Neurol* 2009; 219 258–265

# Electrical stimulation for cauda equina injury

Time of commencing stimulation post-injury

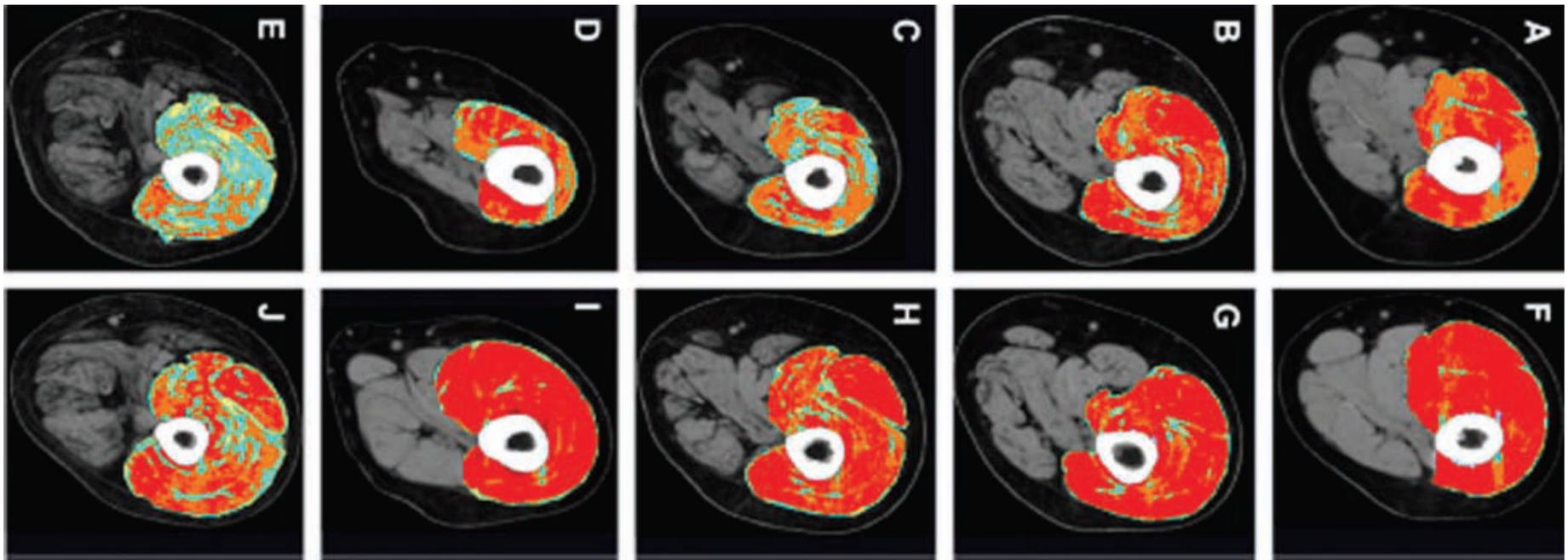
5.4 yrs

3.2 yrs

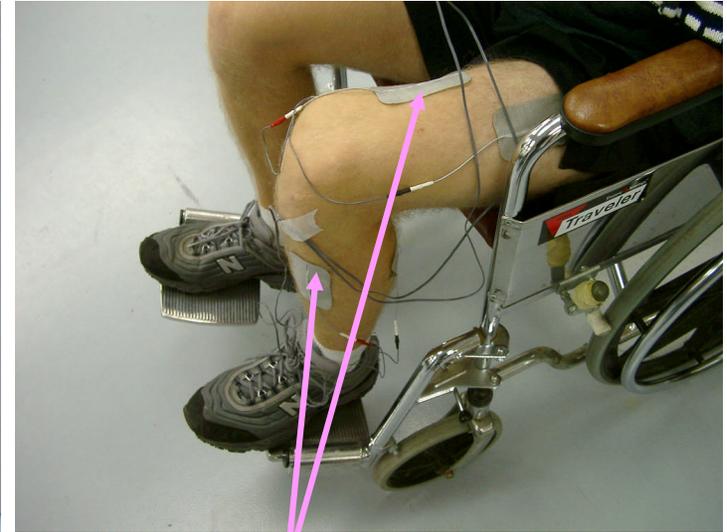
1.7 yrs

1.2 yrs

0.8 yrs



# Functional electrical stimulation



Electrodes applied to large muscle groups

Multi-channel stimulator

# Inhibitory techniques



Inhibitory casts / serial casts



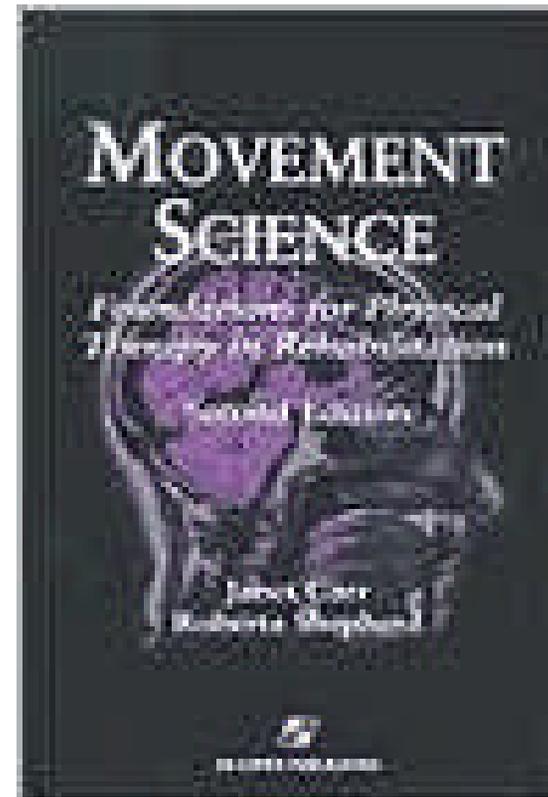
Prolonged icing

Price et al. 1993 *Arch Phys Med Rehabil* 74:300-304 ; Zankel 1966 *Arch Phys Med Rehabil* 47:787-792;  
Sussman & Cusick, 1979 *Johns Hopkins Med J* 145:112-114

# Motor Relearning Framework

Theoretical framework based on:

- Motor learning
- Motor control
- Biomechanics
- Muscle biology
- Task-specific training



Carr JH, Shepherd RB. 1987 A motor learning model for rehabilitation. Ch 2 in Carr JH, Shepherd RB, Gordon J, Gentile AM, Held JM (eds) *Movement Science. Foundations for Physical Therapy in Rehabilitation*.

# Dynamical systems theory

- Emphasis on process rather than hierarchic structures
- Multiple subsystems contribute to motor behaviour
  - Neurological
  - Biomechanical
  - Psychological
  - Task
  - Context

# Dynamical action/synergetics perspective

- Motor control
  - How do patterns and organization come into being from their constituent parts?
  - How do these systems change over time? (non-linear properties of the system; transitions in behaviour)
- Task-specificity and context of the action
  - opportunities for practice
- Behaviour as an emergent

# Implications for therapeutic practice

- Are there constraints in subsystems that limit motor behaviour? (e.g. contractures, weakness)
- Does the therapeutic environment afford opportunities to practise tasks in a meaningful and functional context?
- Do activities promote exploration of a variety of movement patterns?
- Manipulate control parameters such as speed or force to facilitate attainment of therapeutic goals