

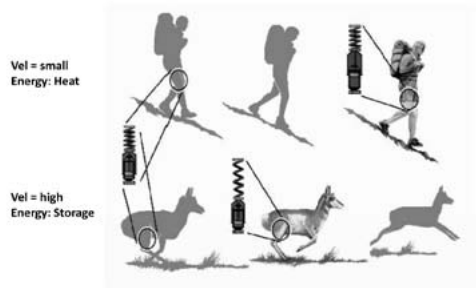
学術講演会報告

# Nerve Muscle Tendon -Physiological Unit for a Functional Training?

Albert Gollhofer<sup>1)</sup>



## □ Nerve-Muscle-Tendon



From: Lindstedt et al. 2001



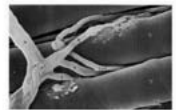
## Nerve - Muscle - Tendon: Physiological Unit for a functional training

Albert Gollhofer, Uni Freiburg



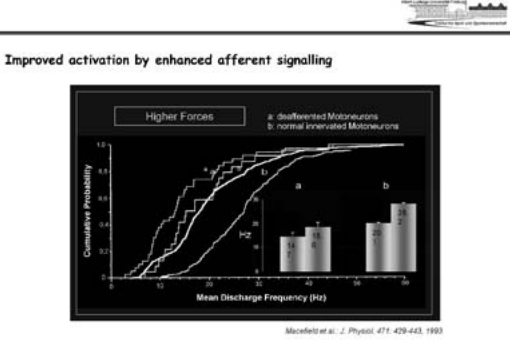
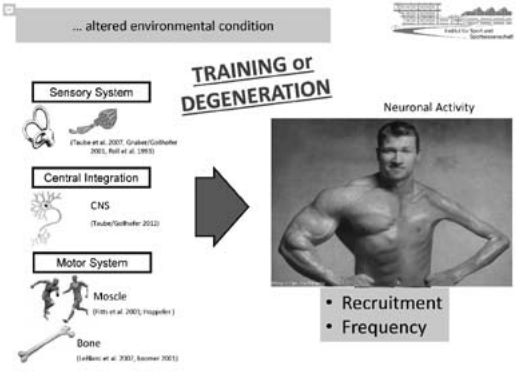
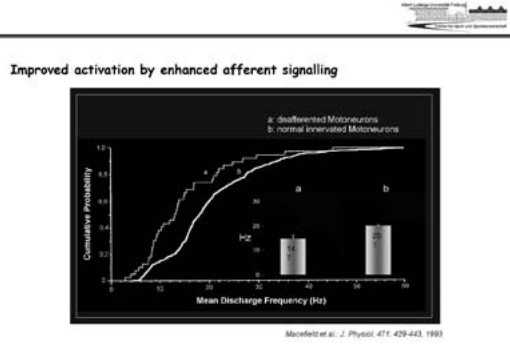
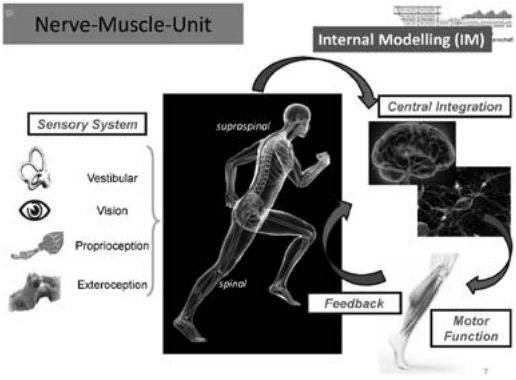
### Content:

- Nerve - Muscle Interaction
  - Physiology
  - Training: Adaptational Aspects
- Muscle - Tendon Interaction
  - Physiology
  - Training: Adaptational Aspects
- Conclusion



<sup>1)</sup> University of Freiburg

# Nerve Muscle Tendon -Physiological Unit for a Functional Training?



## Nerve – Muscle:

### Enhancement of neural drive to the muscle?

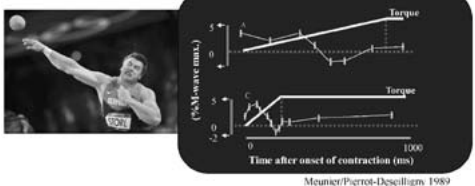
1. Enhancement of spinal afferent contributions
2. Reductions of antagonist activation (reciprocal inhibition)
3. Enhancement of supraspinal activation



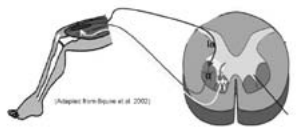
### Importance for Power

#### Rate of Force Development

#### Supplementary facilitation during contraction (%Mmax)

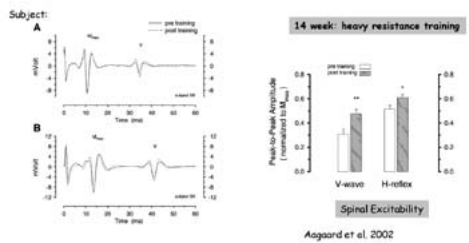


### 1. Question: How can spinal mechanisms contribute to an enhanced neural drive?



Purpose:  
Improved activation by enhanced afferent activation

### Spinal excitability after Strength Training



**In Summary:**  
Spinal excitability after Strength Training

**Assumed Mechanism:**  
- Reduced Presynaptic Inhibition of Ia-afferents

Lagerquist et al. 2006  
Aagaard et al. 2002  
Gollhofer et al. 2003

**Acute Effects:**

- HL - High-Load
- LL - Low-Load
- BFR-C - Bloodflow restriction contin.
- BFR-I - Bloodflow restriction intermitt.

**Elbow flexion exercises:**

Week	1RM (%)	Load (kg)	Time (min)	Rest (min)	Repetition reserve (%)	Intensity	Volume
HL	70	15	10	1:30	10	100	100
LL	30	5	10	1:30	10	100	100
BFR-C	30	5	10	1:30	10	100	100
BFR-I	30	5	10	1:30	10	100	100

**FIGURE 1** MEP amplitude relative to Mmax following resistance training... (text partially obscured)

Brandner et al. 2015

**2. Question: Suppression of neural drive to antagonistic muscles**

Increased central facilitation of antagonist reciprocal inhibition at the onset of denatification following explosive strength training

David S. Keating, Brian Lamberton-Davis, and Dan S. Nolte

**Explosive type of strength training of Tibialis inhibits the Soleus**

**Avoid activation of antagonistic muscle**

**Nerve – Muscle:**

**Enhancement of neural drive to the muscle?**

1. Enhancement of spinal afferent contributions
2. Reductions of antagonist activation (reciprocal inhibition)
3. Enhancement of supraspinal activation

**In Summary:**  
Reduced neural drive to antagonistic muscles: DRI

**Mechanism:**  
Changes in Presynaptic Inhibition (PSI)

Journal of Neuroscience Methods 2008

**Muscle-Tendon Unit**

Composition:  
Evolution  
Functional importance

Bramble & Lieberman 2004

**3. Question: Enhanced supraspinal drive to the muscles**

**Purpose:**  
Determine cortico-spinal excitability before and after strength training

**MEP - Motor evoked Potential**

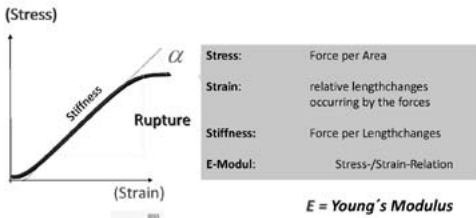
**RESEARCH ARTICLE**  
Differences in gibbon locomotion: springs or strings?

Prosser, J. and Anthony J. Channon

© 2006, Kluwer Academic Publishers, Springer and "Structure and Motor Laboratory"  
D. Gompf, A. Hildebrand, and G. Hildebrand

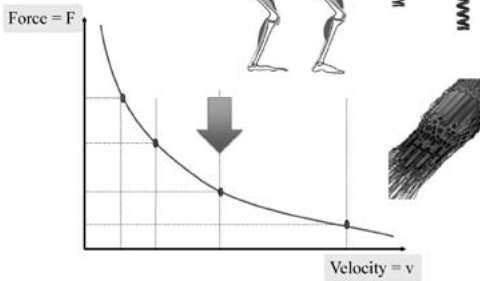
MTUL, TL, ETL, Triceps surae, MTUL, ETL, Quadiceps femoris

## Damping\_System



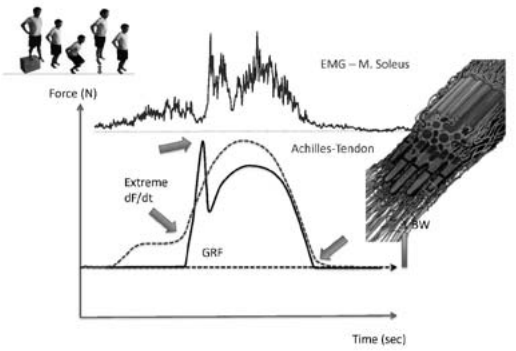
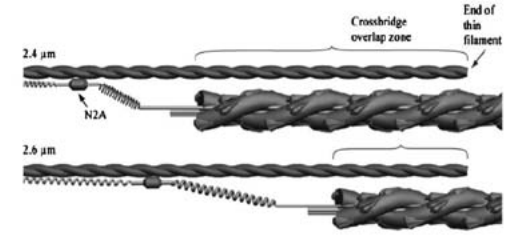
Importance of Tendon\_Compliance:

- Limitation  $df/dt$
- No jerks
- Reduced velocity of contraction



## Muskel\_Titin: New Hypothesis .....

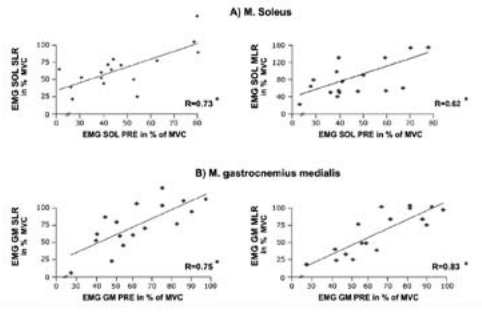
What Is the Role of Titin in Active Muscle?  
 James A. Mairiaux, Gerard L. Fowles, Leslie A. Gilmanoff, Theodor A. Ueno, C. Vann, L. Lindahl, and Klaus C. Niebauer, *Exercise and Sport Sciences Reviews*, 2012



## Power-System Energy\_Storage



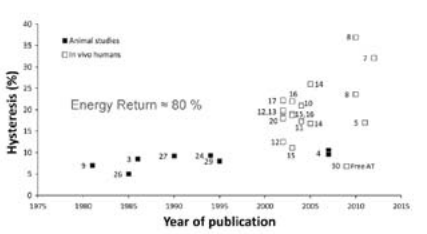
## Correlation: Preactivity and Reflexcomponents



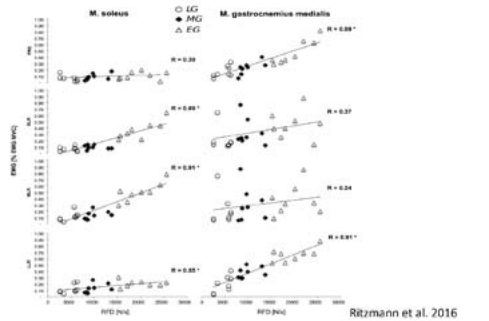
Helm et al. 2019

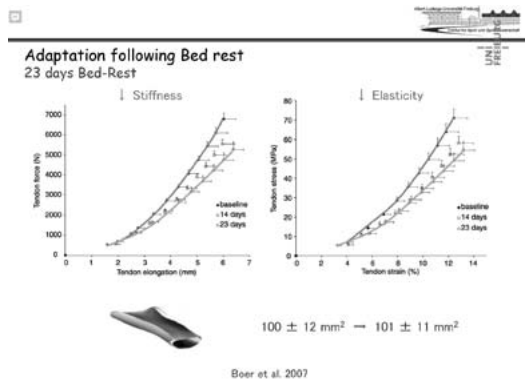
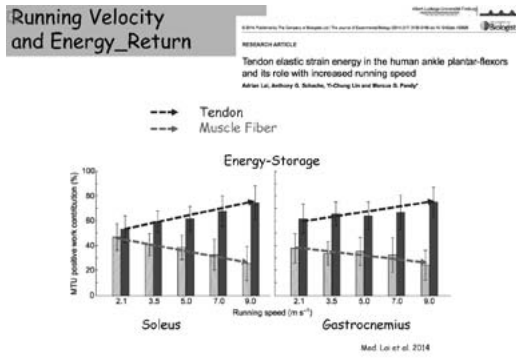
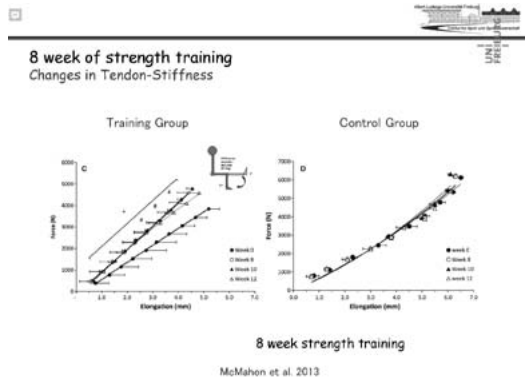
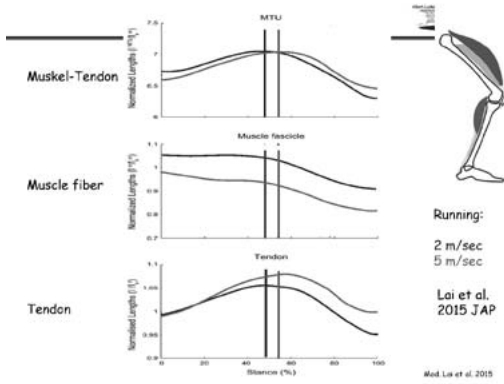
## Tendon as a potential energy storage system

In vivo / human studies



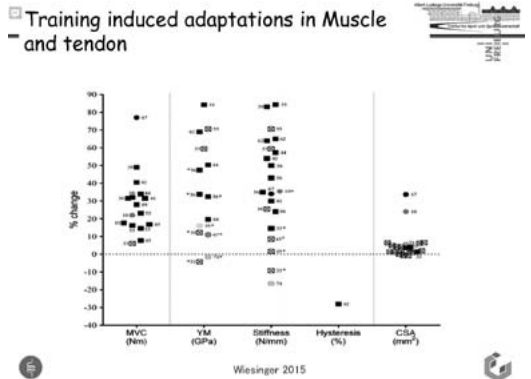
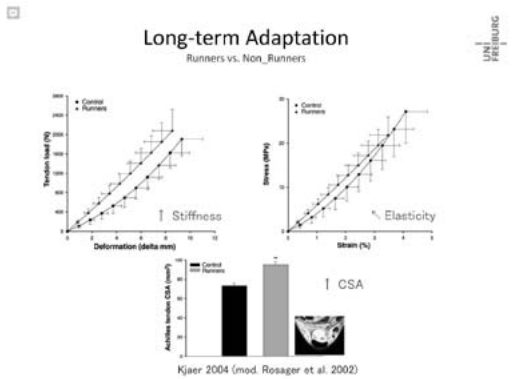
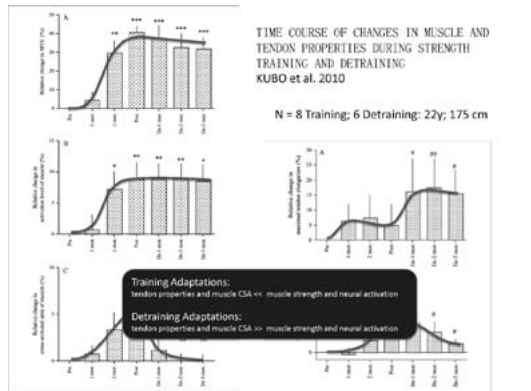
## Correlation: Preactivity, Reflexcomponents and Rate of Force

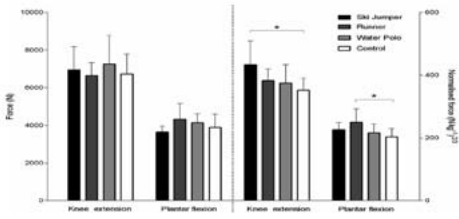




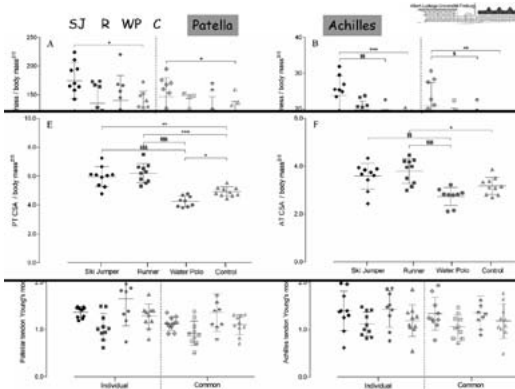
**Application in Sports**

What can be trained ??  
How is it trained ??

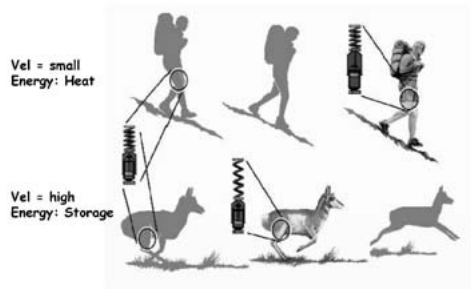




Wiesinger et al. 2016



Nerve-Muscle-Tendon



From: Lindstedt et al. 2001

