



Acute and chronic neuromuscular adaptations to local vibration

Toward a new neuromuscular rehabilitation modality

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Un peu de sport



Je suis très motivée



ACTIVITE PHYSIQUE

ActiFS

FATIGUE

SANTE



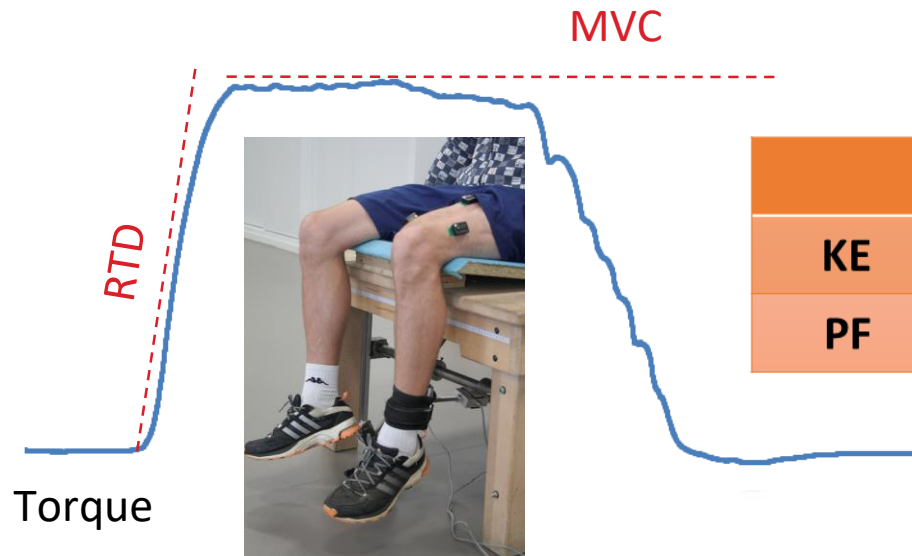
Hypoactivity and deconditioning



Hypoactivity and neuromuscular deconditioning



24 days of unilateral lower limb suspension



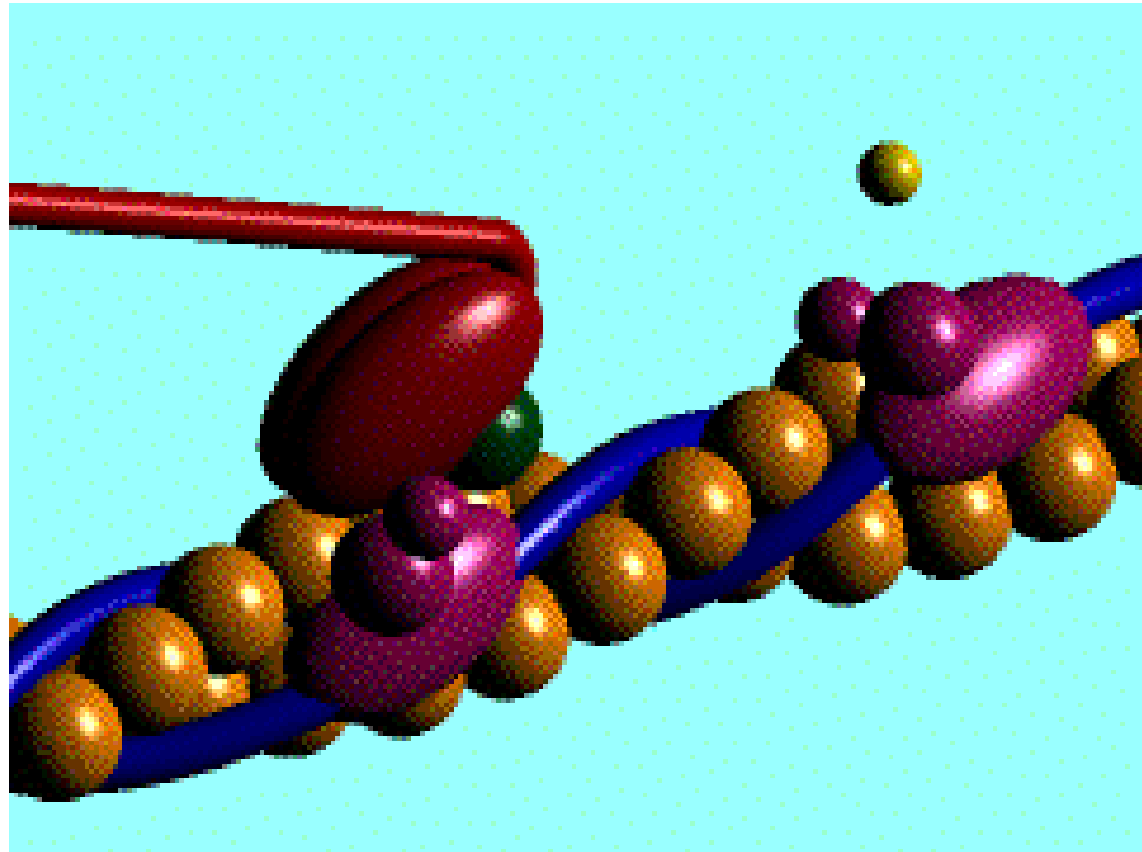
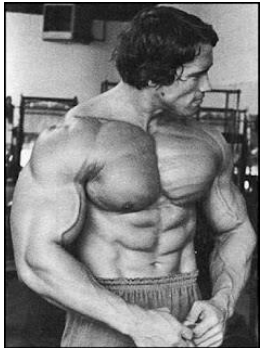
	MVC	RTD
KE	-21%	-16%
PF	-12%	-17%

SJ two legs: **-20%**
 SJ one leg: **-28%**

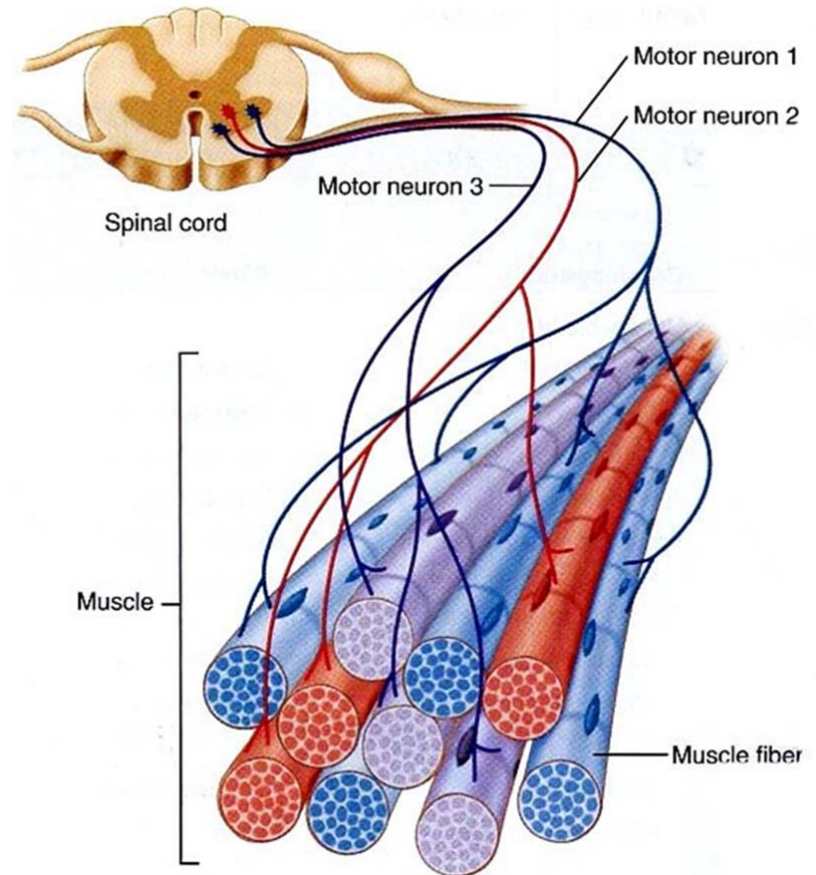
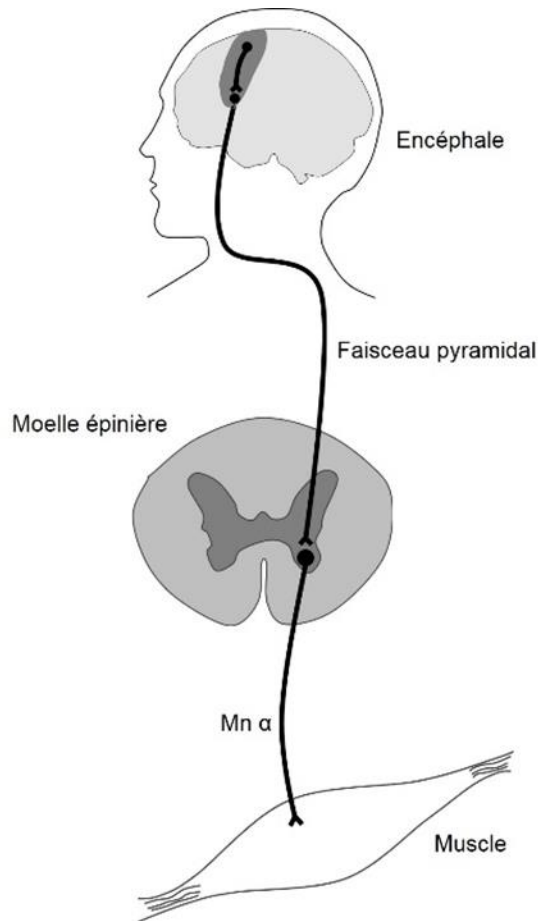




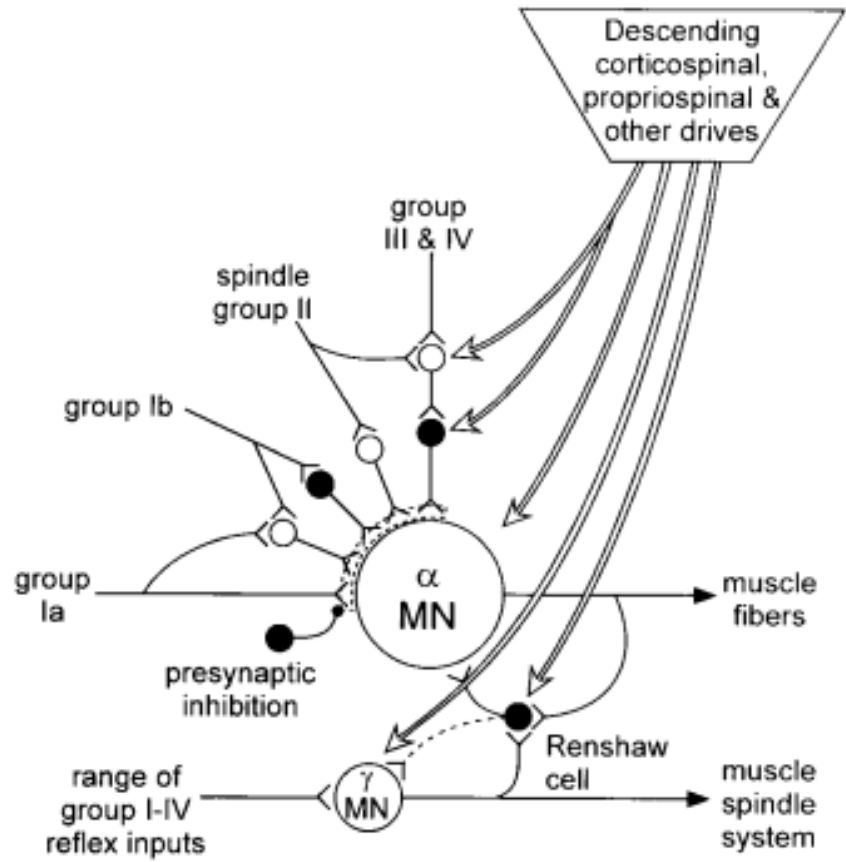
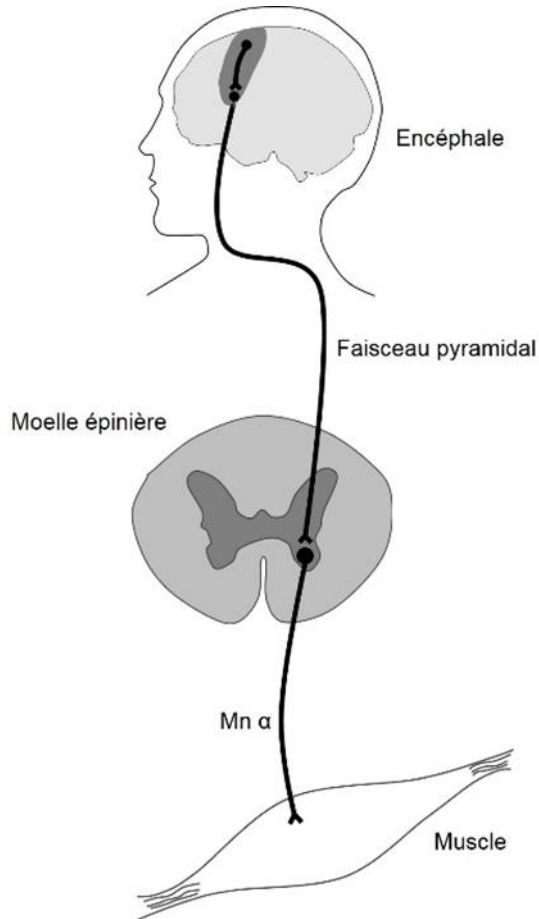
How to explain neuromuscular deconditioning ?



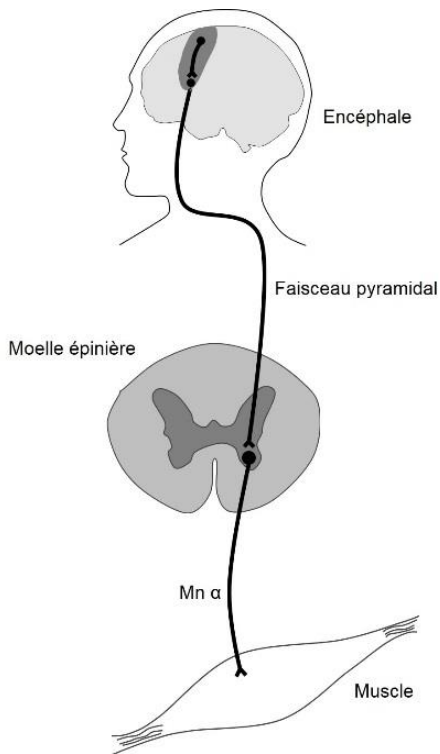
But muscular force does not only rely on muscle mass...



What are the inputs involved in motor units recruitment ?

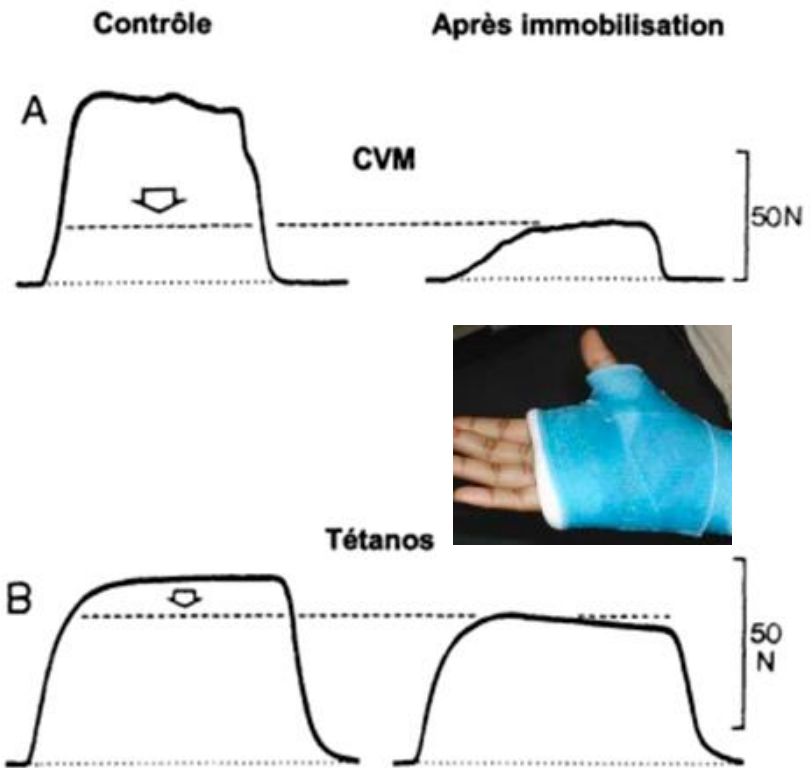
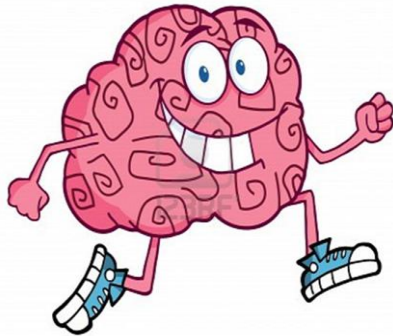
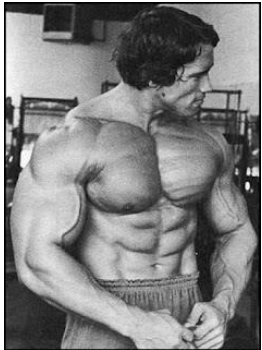


Neuromuscular plasticity : from comand to movement

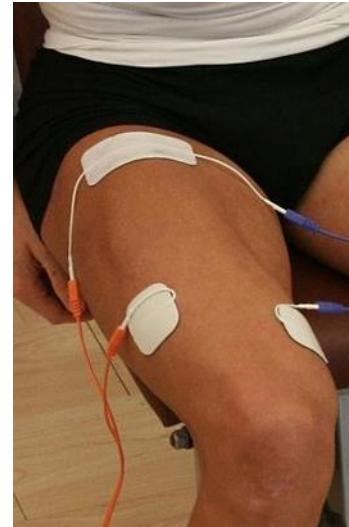




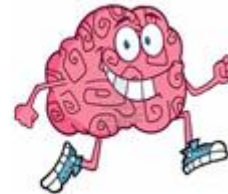
How to explain neuromuscular deconditioning ?



What are the countermeasures to prevent neuromuscular deconditioning or promote reconditioning ?



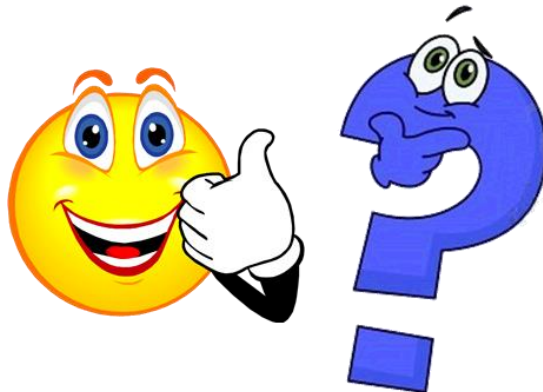
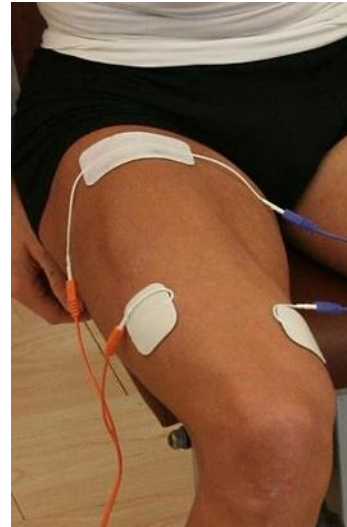
Proven efficacy



Not appropriate in case of impossible or painful contractions

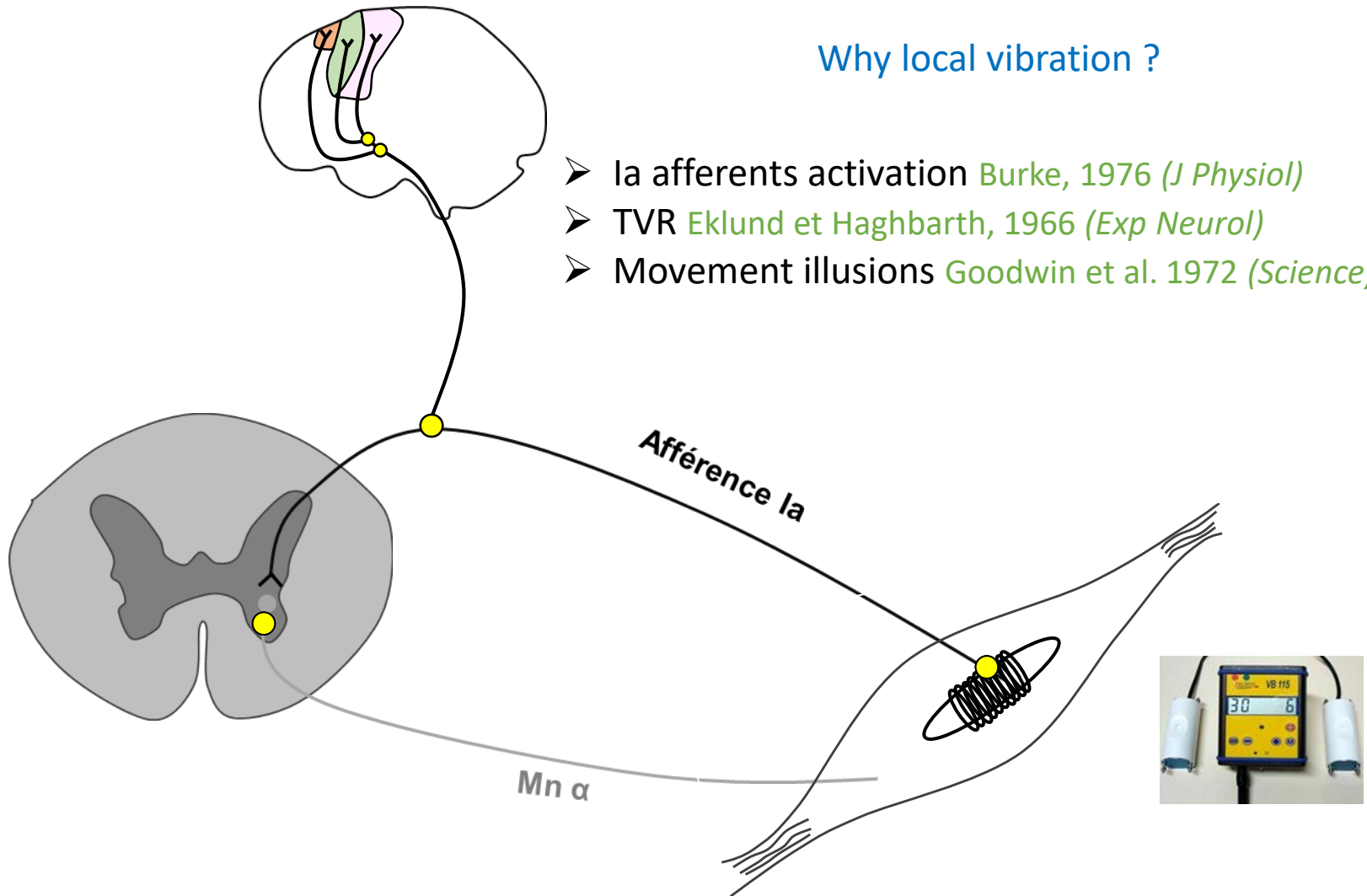


What are the countermeasures to prevent neuromuscular deconditioning or promote reconditioning ?



Why local vibration ?

- Ia afferents activation [Burke, 1976 \(J Physiol\)](#)
- TVR [Eklund et Haghbarth, 1966 \(Exp Neurol\)](#)
- Movement illusions [Goodwin et al. 1972 \(Science\)](#)

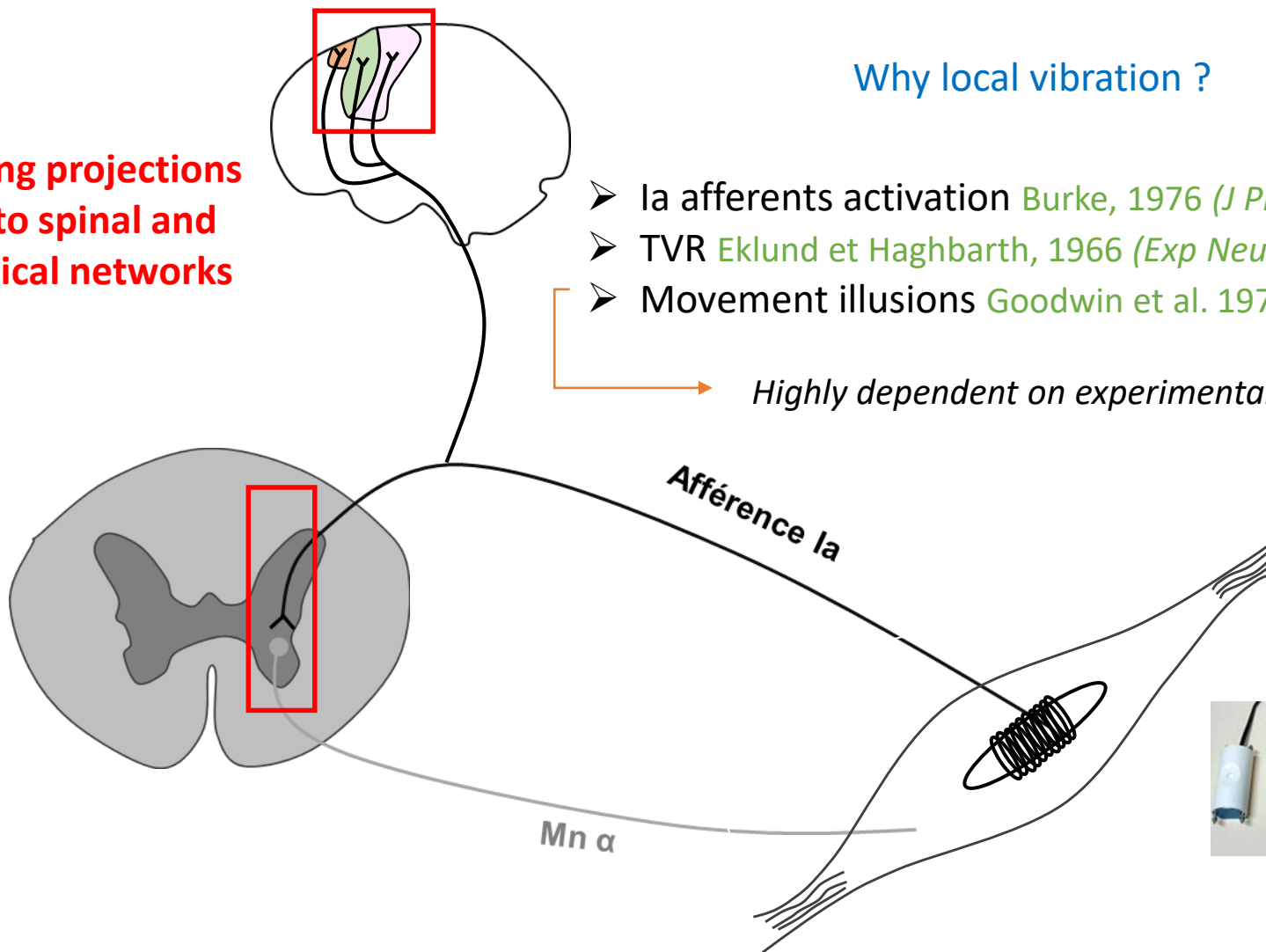


Strong projections onto spinal and cortical networks

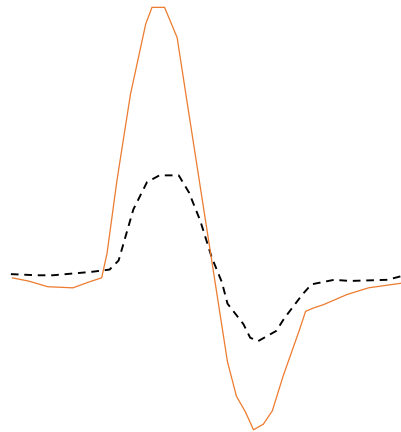
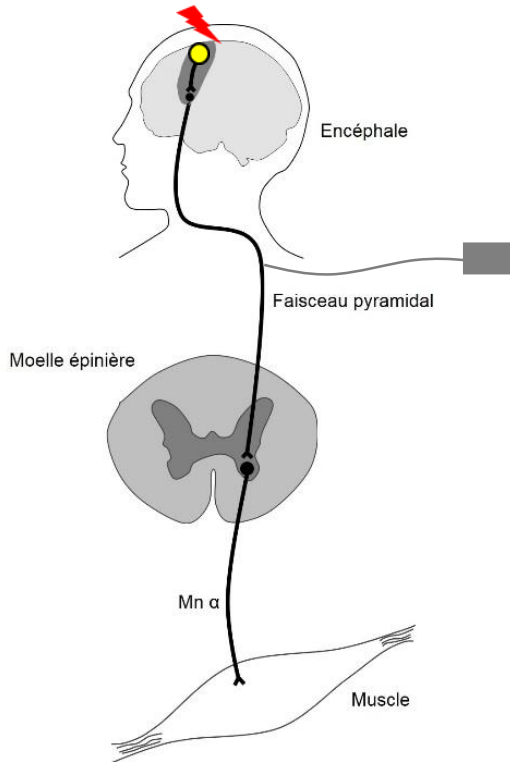
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Highly dependent on experimental conditions



Modulation of corticospinal excitability during local vibration

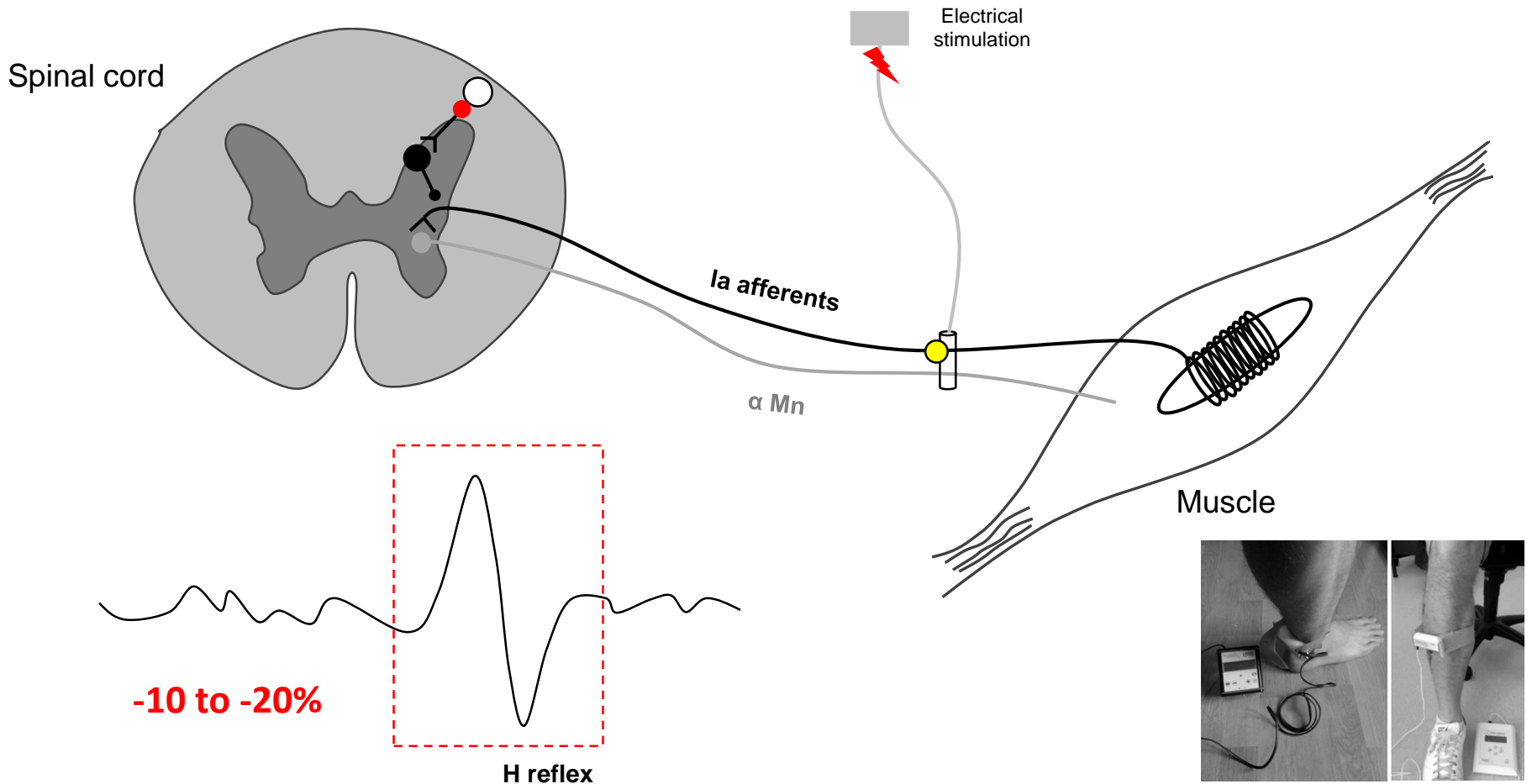


x3

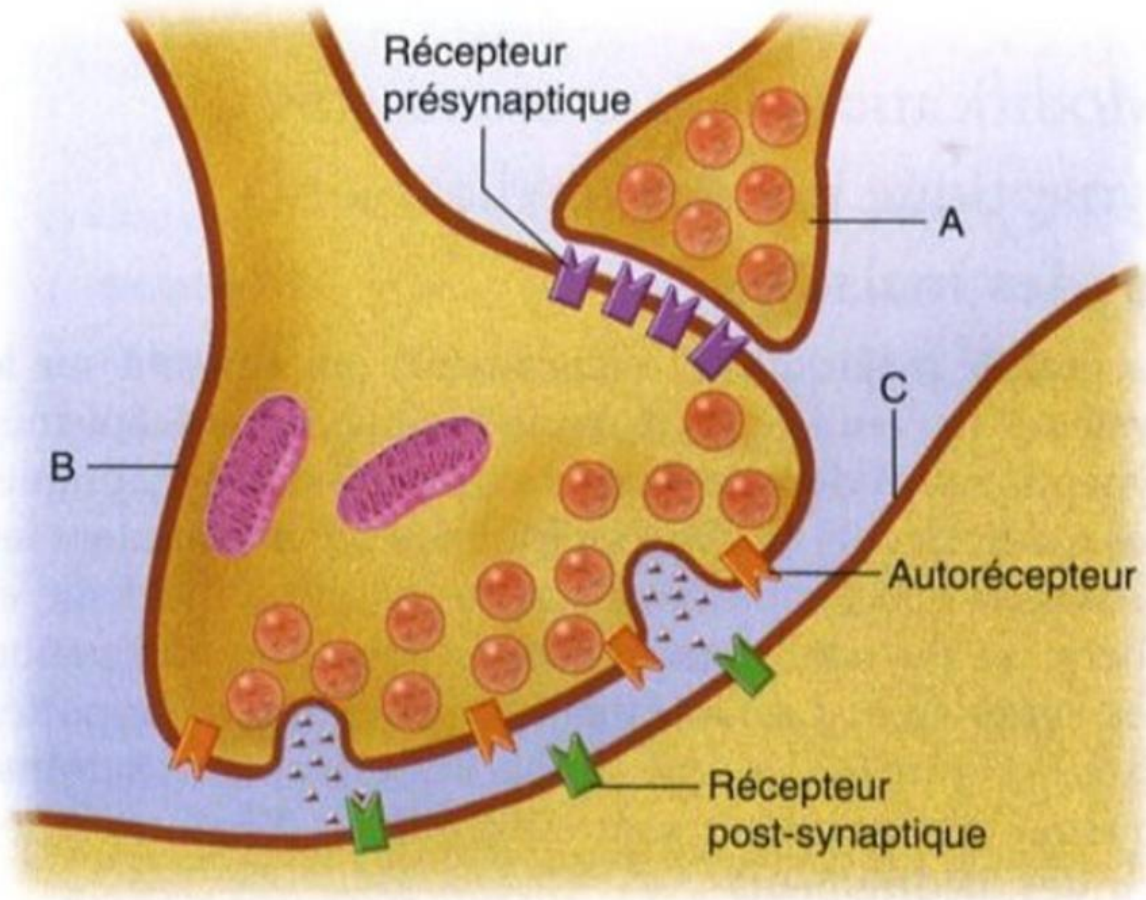
Spinal or cortical in origin ? What about TMEPs and paired-pulse TMS ?

Lapole et al., 2015 (Exp Brain Res); Souron et al., 2018 (Front Physiol)

Acute effects of prolonged exposure to local vibration on spinal excitability

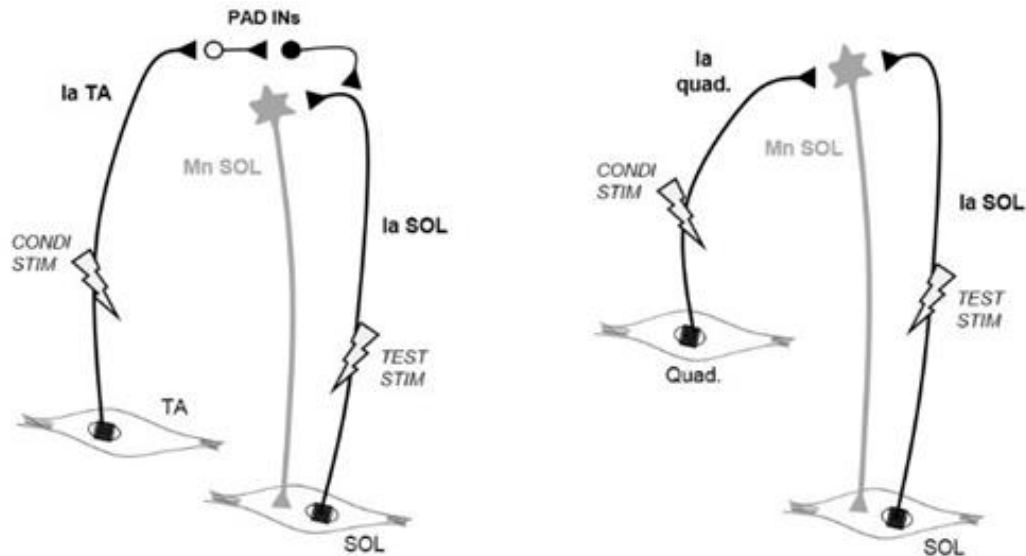
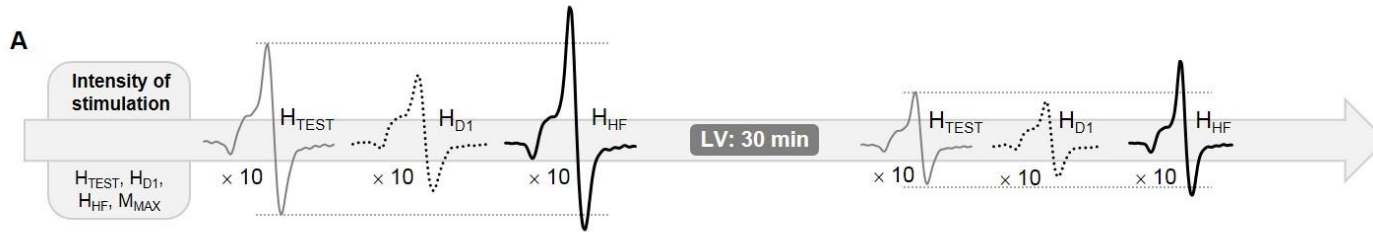


Acute effects of prolonged exposure to local vibration on spinal excitability

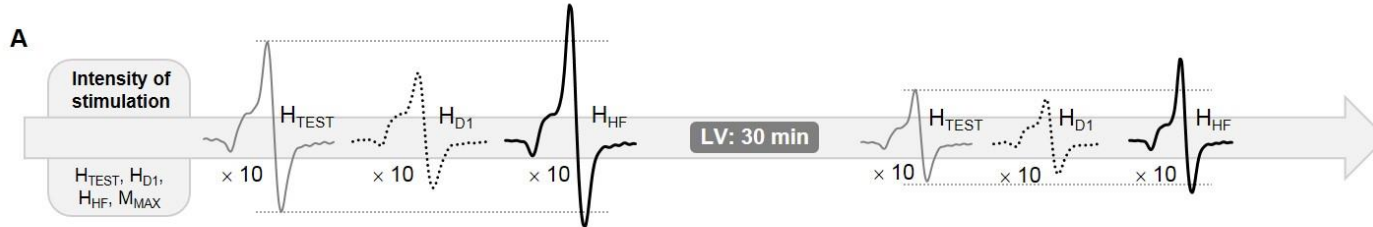




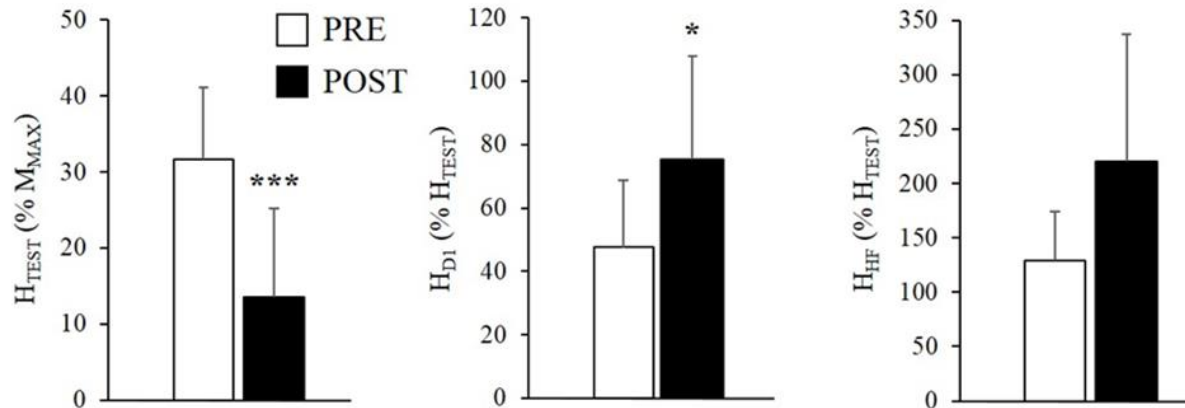
Vibration-induced depression in spinal loop excitability revisited



Vibration-induced depression in spinal loop excitability revisited

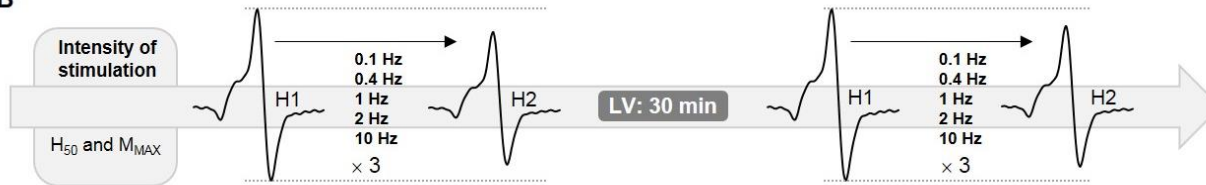


A. S_H depress

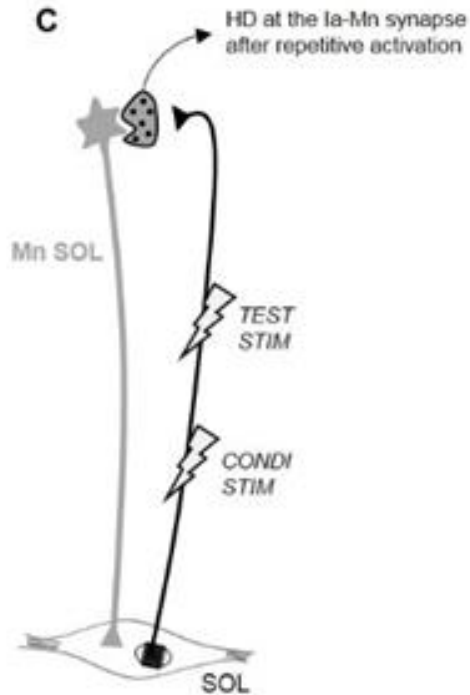


Vibration-induced depression in spinal loop excitability revisited

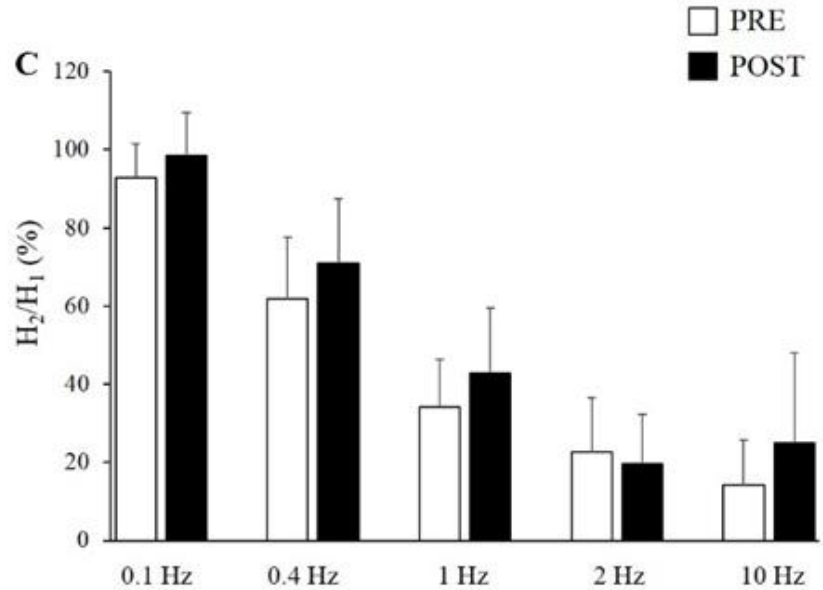
B



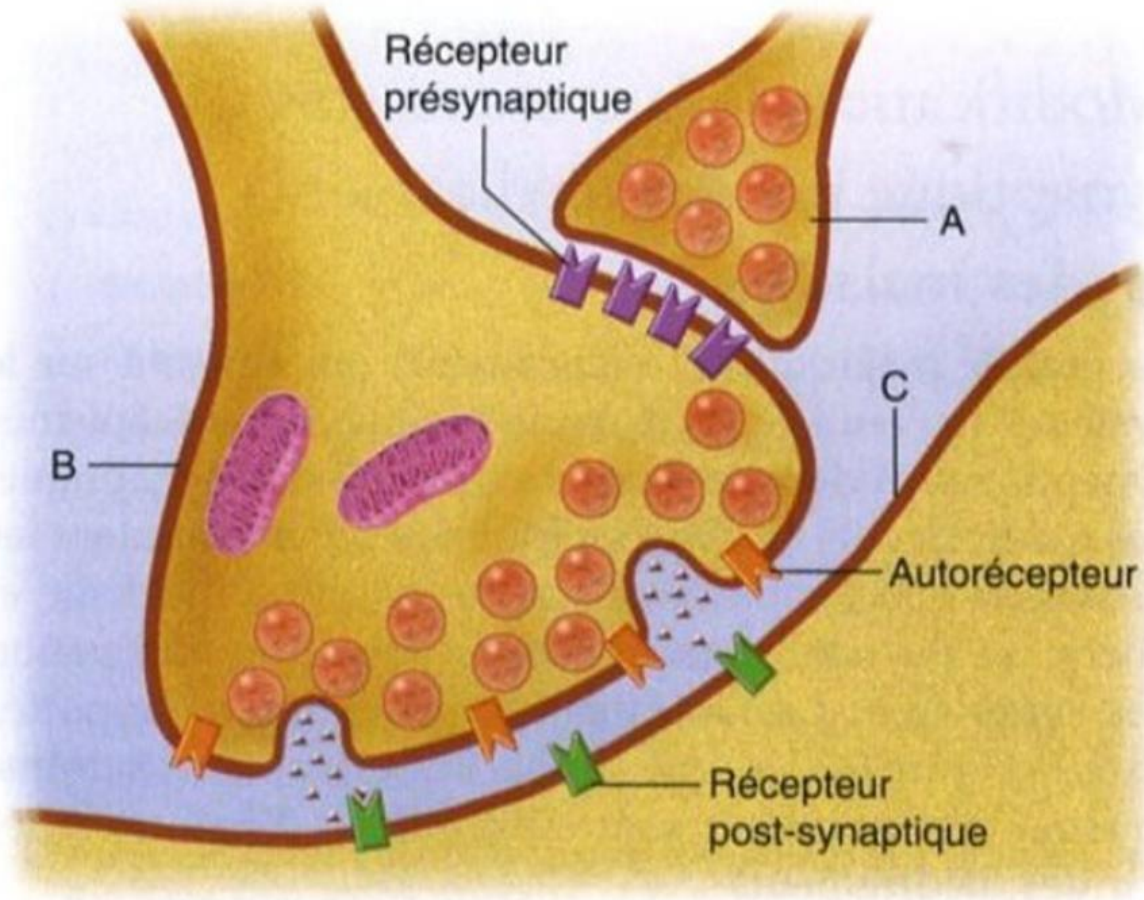
C



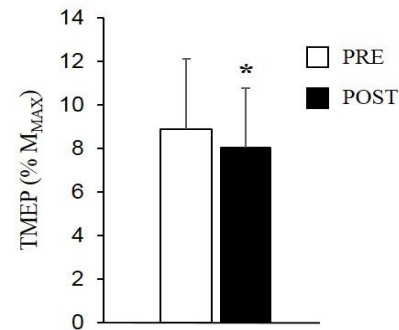
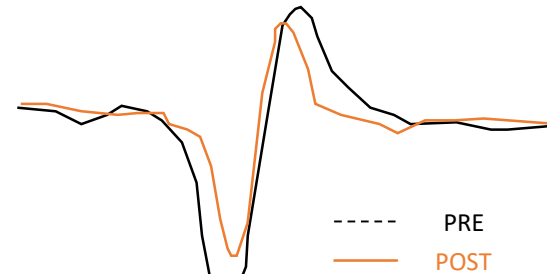
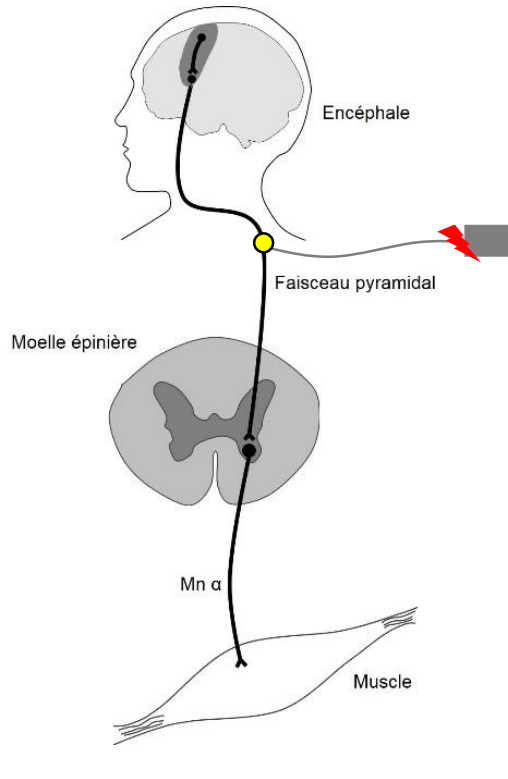
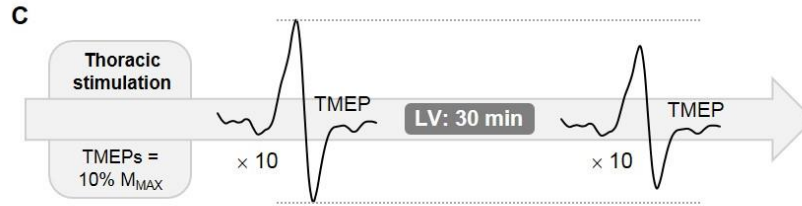
C



Vibration-induced depression in spinal loop excitability revisited



Vibration-induced depression in spinal loop excitability revisited

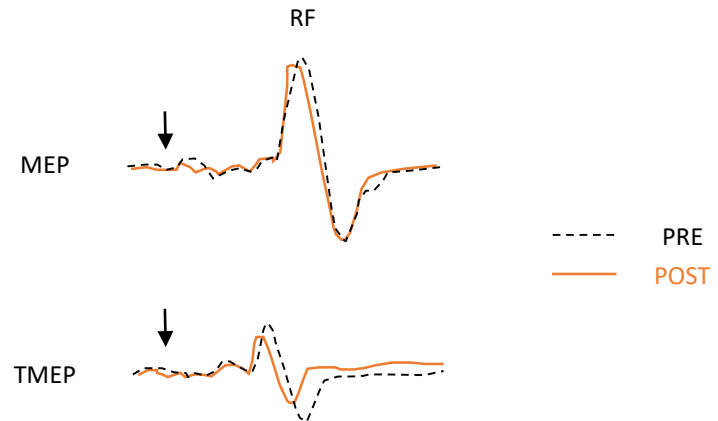
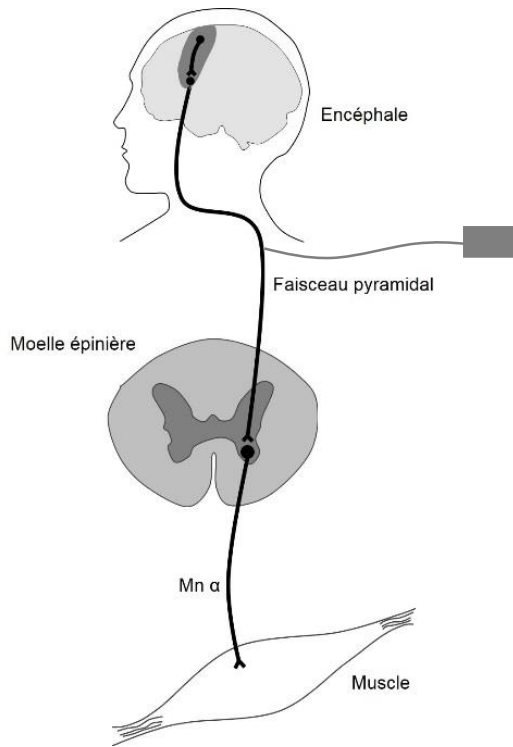


-13%

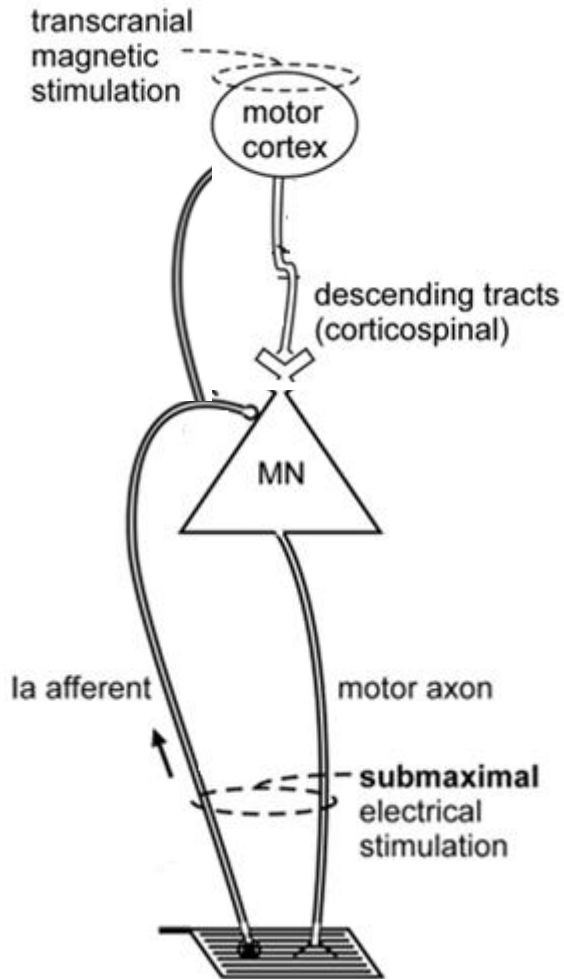
Souron et al., soon I hope



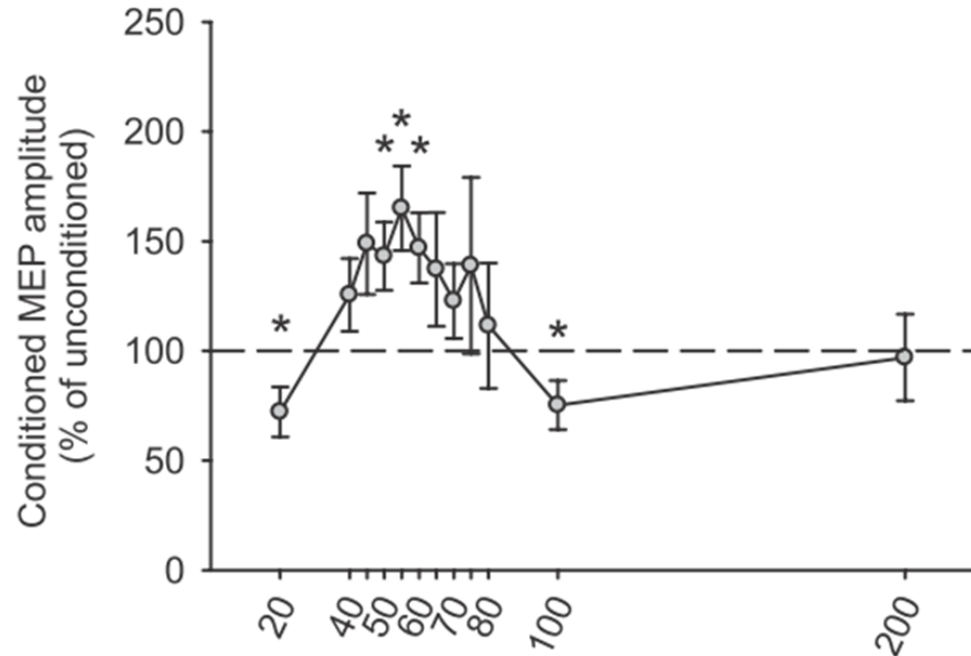
Acute effects of prolonged exposure to local vibration on corticospinal excitability



Can local vibration induce changes in sensorimotor integration ?



Median Nerve Stimulation



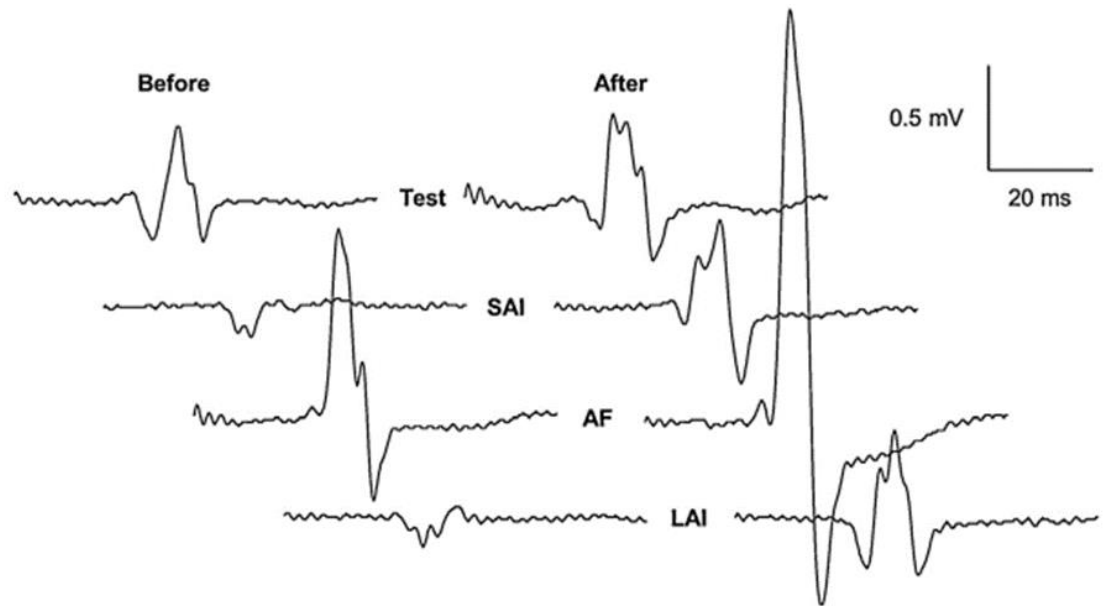
Can local vibration induce changes in sensorimotor integration ?



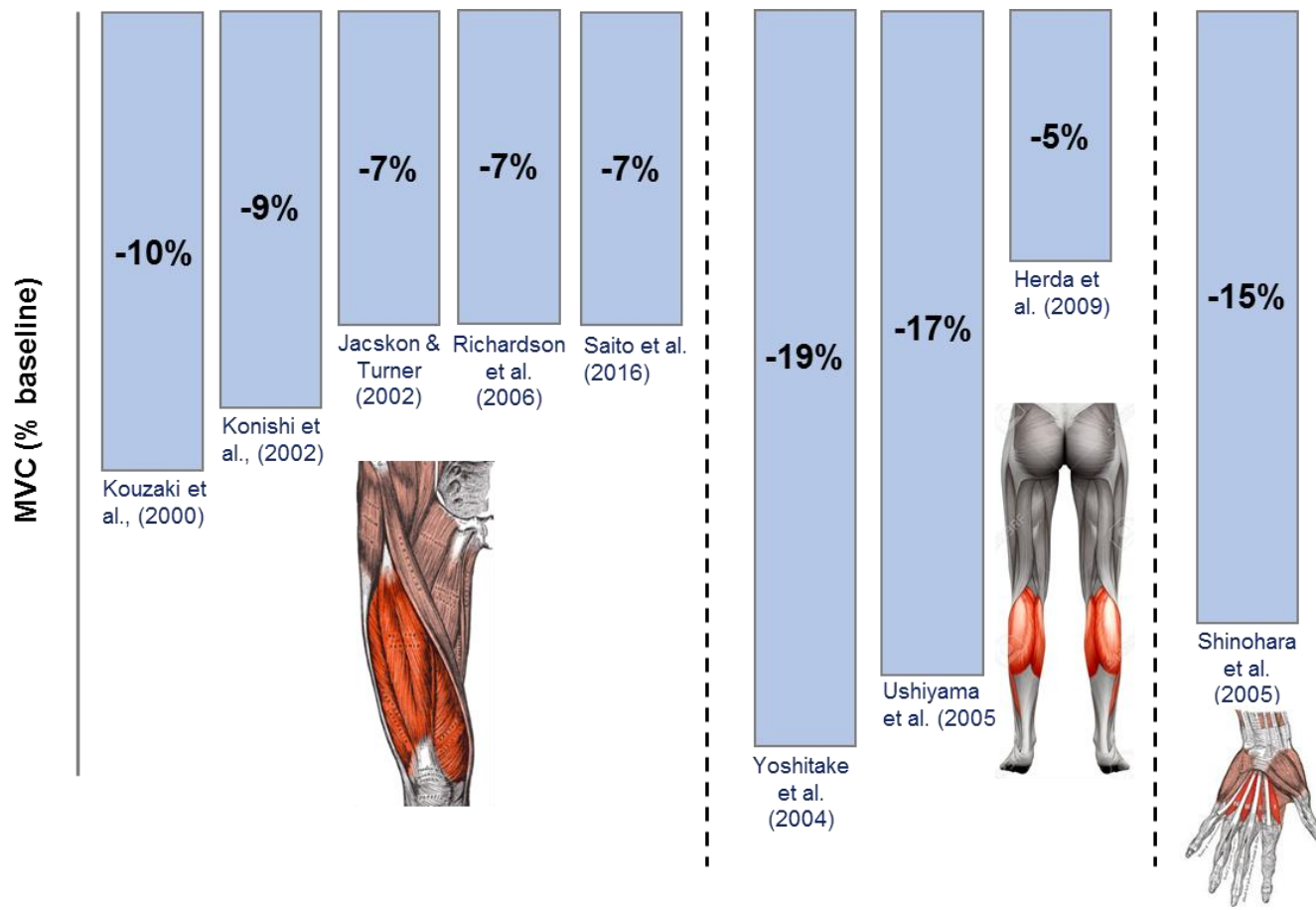
15 min

Changes in sensorimotor integration

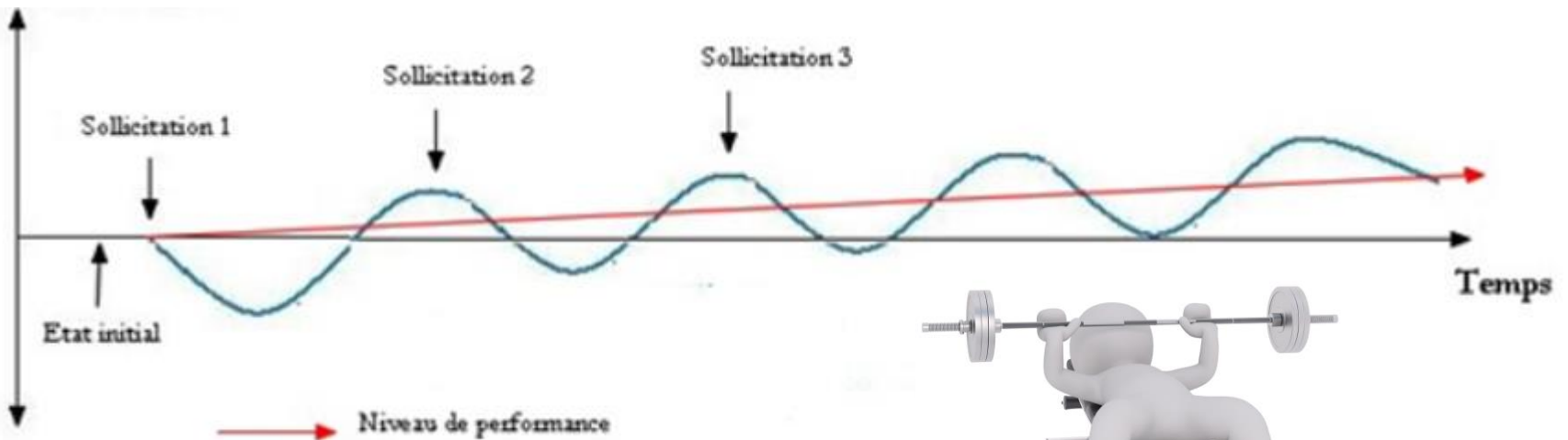
Responders vs non-responders



Acute effects of prolonged exposure to local vibration on force production



Can we use local vibration as a modality to prevent neuromuscular deconditioning ?

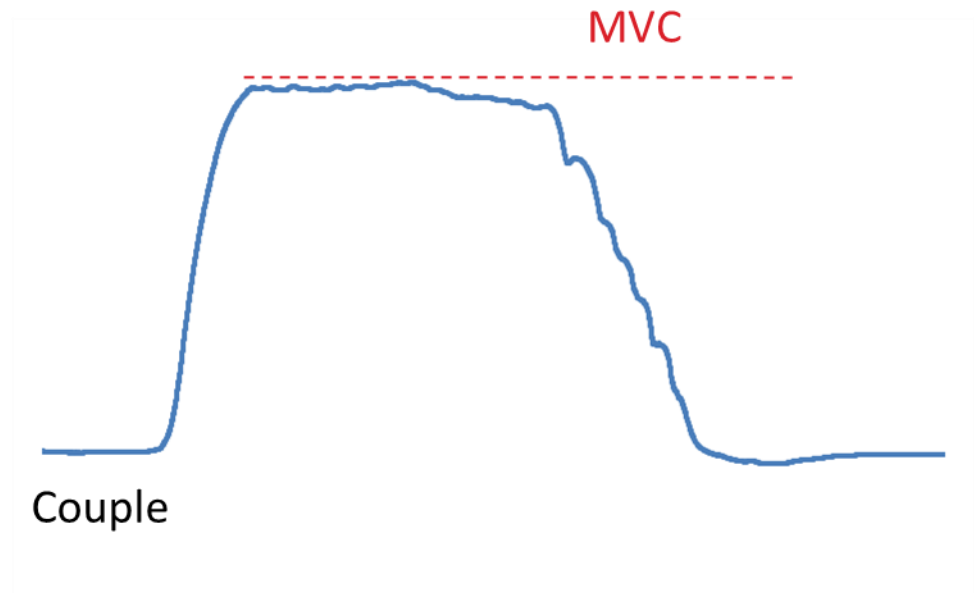


- Validation in healthy subjects
- What are the mechanisms involved in acute and chronic adaptations to local vibration
- Toward a clinical application

Effects of repeated Achilles tendon vibration on triceps surae force production

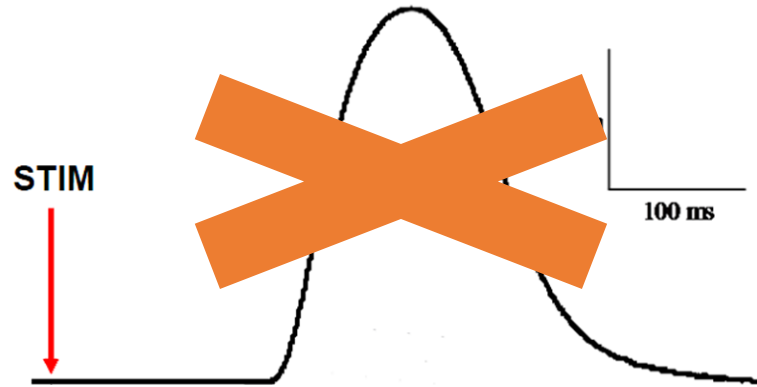
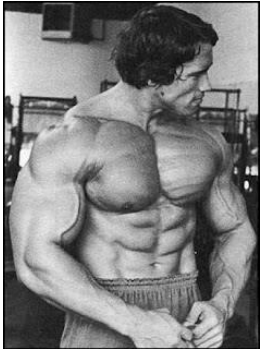


14 consecutive days
1h per day
50 Hz
n = 29



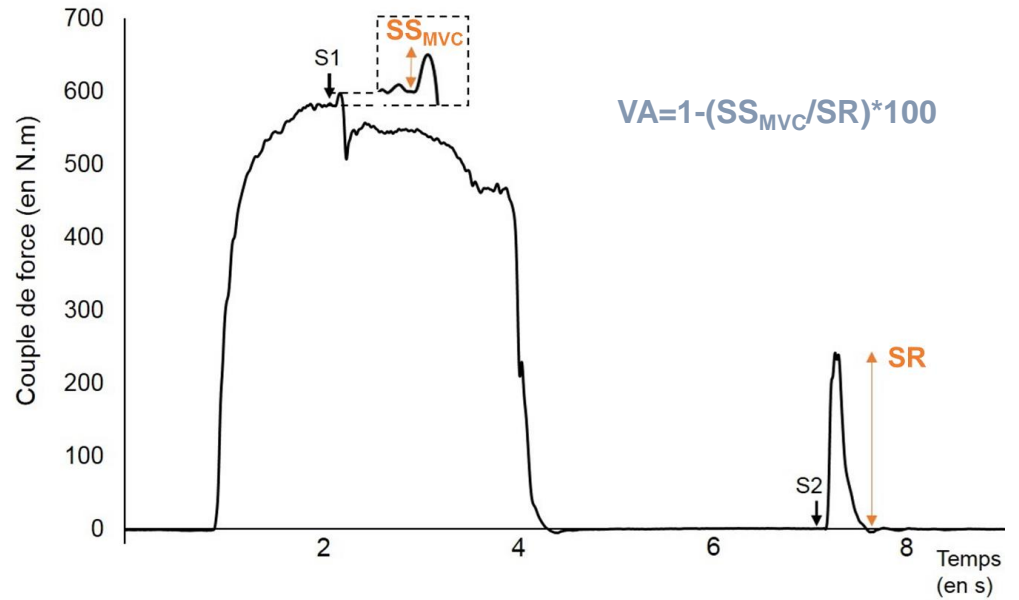
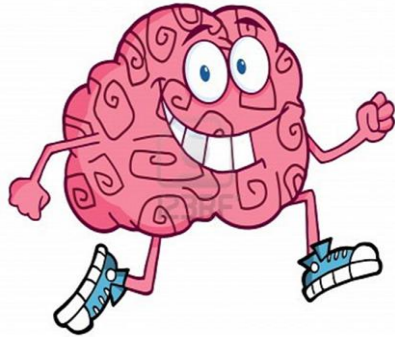
	P1	P2	P3	Post	Benefits (%)
MVC (Nm)	117 ± 29	117 ± 27	119 ± 28	125 ± 28*	6.9 ± 8.3

Effects of repeated Achilles tendon vibration on triceps surae force production



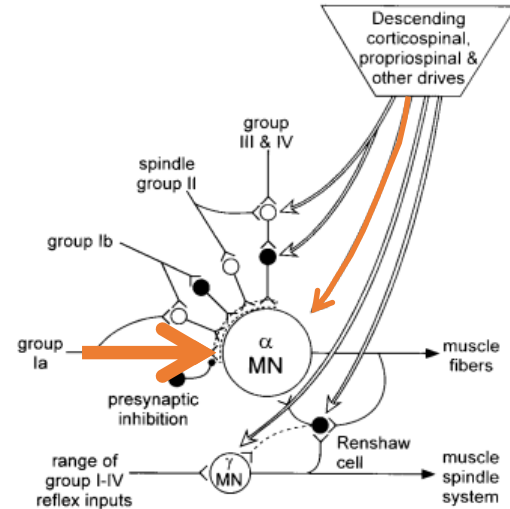
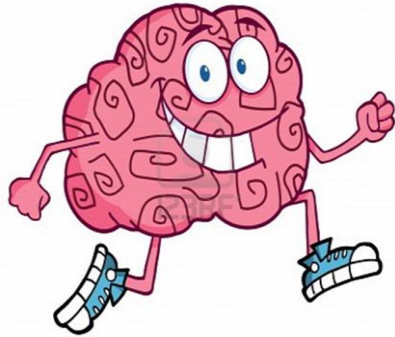
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Effects of repeated Achilles tendon vibration on triceps surae force production

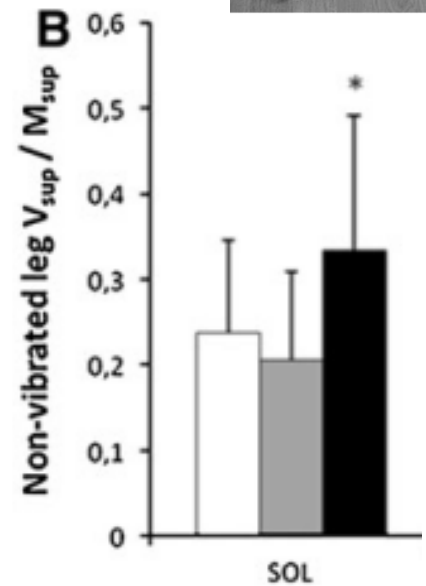
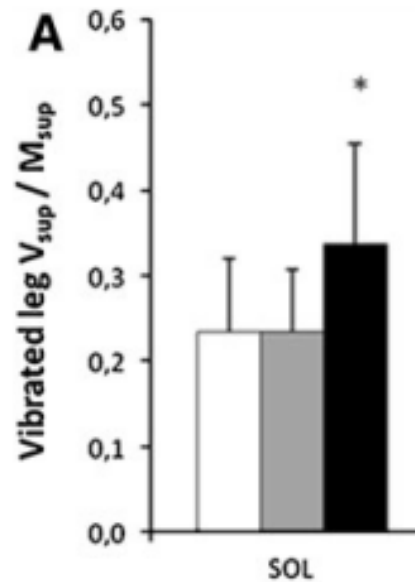
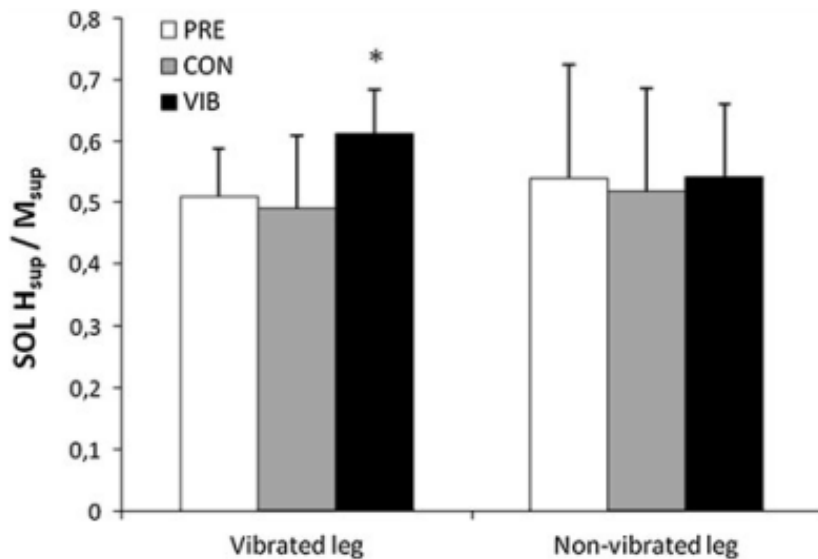


	P1	P2	P3	Post	Benefits (%)
MVC (Nm)	117 ± 29	117 ± 27	119 ± 28	125 ± 28*	6.9 ± 8.3

Ipsi- and contralateral H-reflexes and V-waves after unilateral chronic Achilles tendon vibration

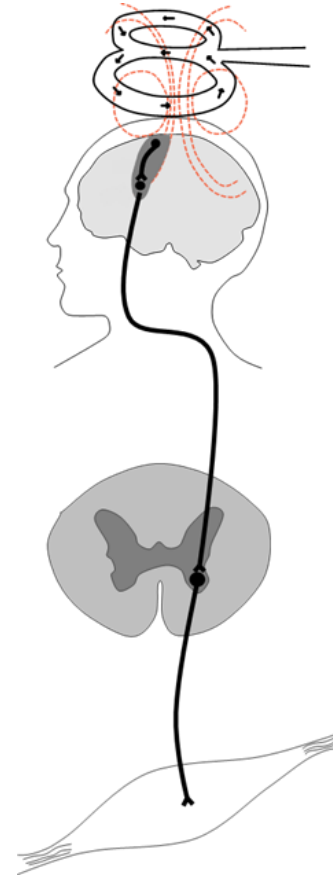
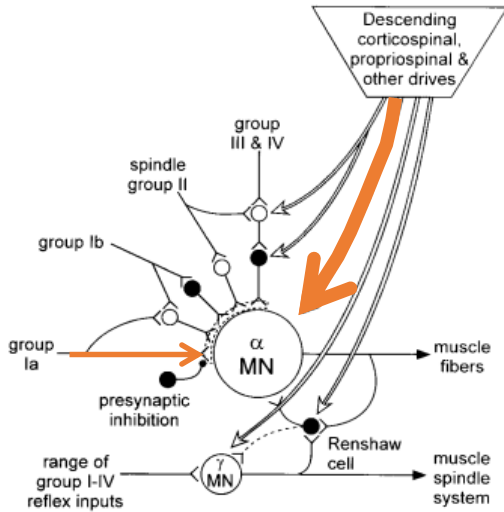
MVC : +10% ... same force improvement on the controlateral leg !

H-reflex and V-waves measurements during MVC



Greater descending neural drive ?

How to identify potential supraspinal adaptations ?



Eight weeks of local vibration training increases dorsiflexor muscle cortical voluntary activation



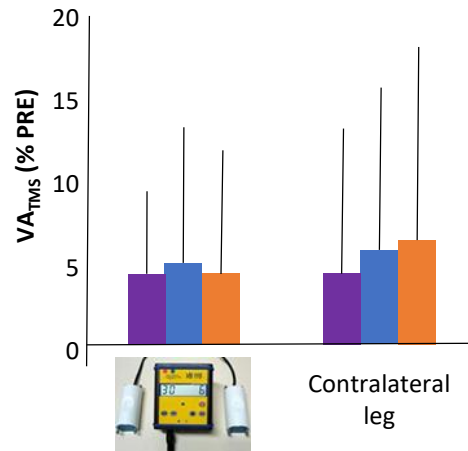
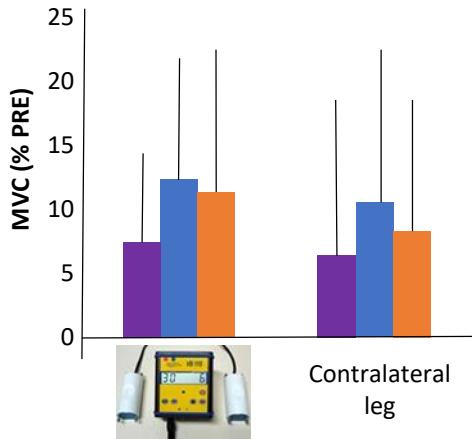
8 weeks
3 sessions (1h) per week
100 Hz

Neuromuscular measurements:

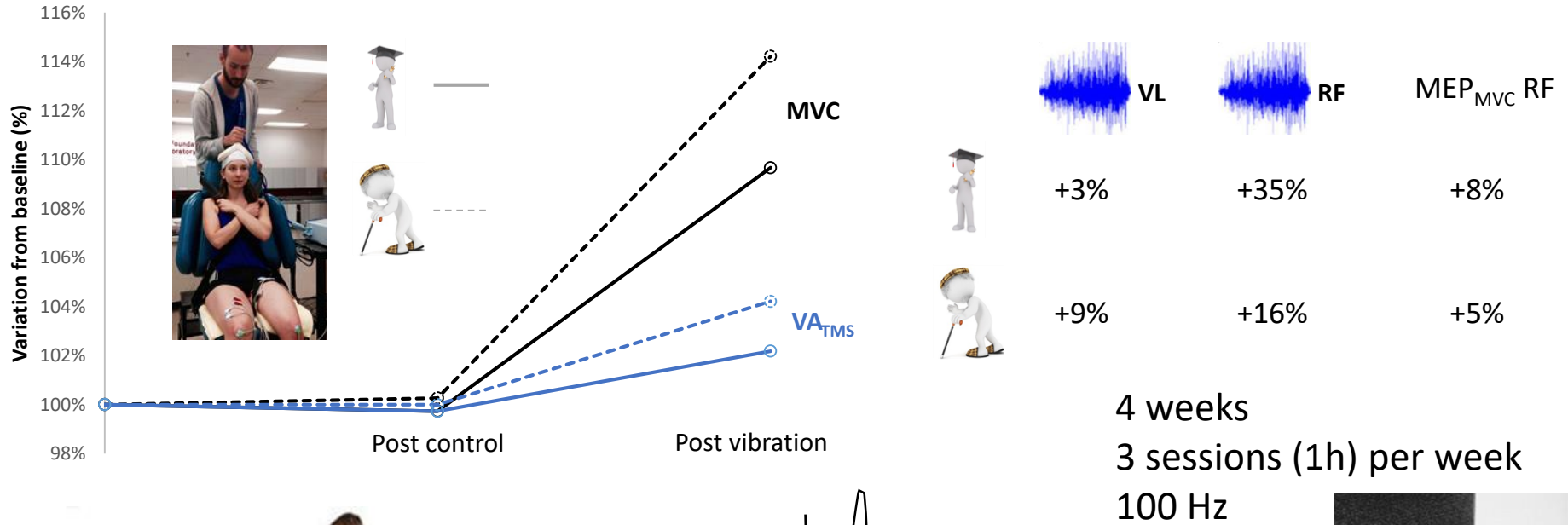
- After 4 weeks of training
- After 8 weeks of training
- 2 weeks after the end of training



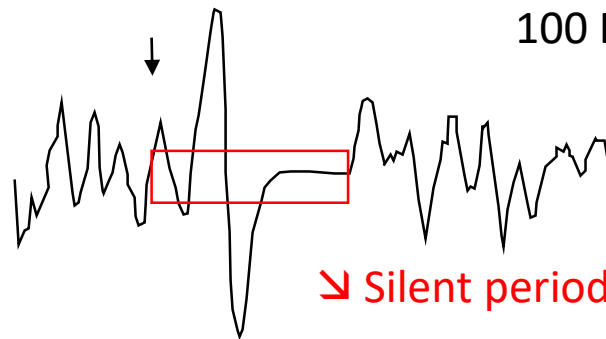
Randomized study
Control group n=22
Tested group n=22



Neural adaptations in quadriceps muscle after 4 weeks of local vibration training in young versus older subjects



SJ : +15%
CMJ : +6%



TAKE HOME MESSAGE

Eur J Appl Physiol
DOI 10.1007/s00421-017-3688-8



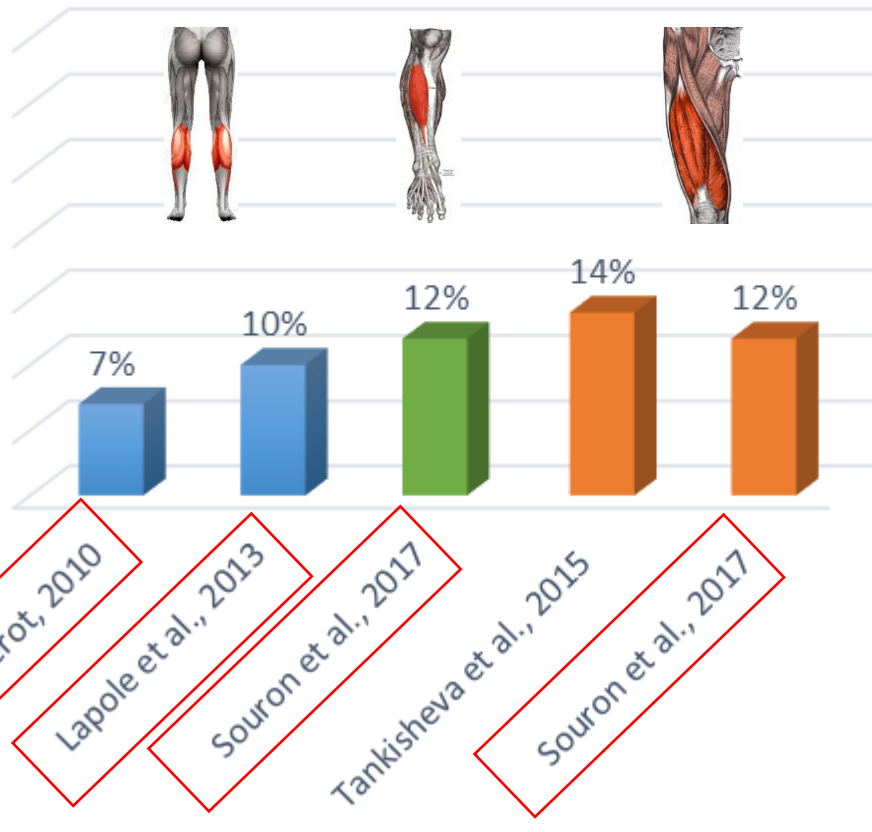
INVITED REVIEW

Acute and chronic neuromuscular adaptations to local vibration training

Robin Souron¹ · Thibault Besson¹ · Guillaume Y. Millet² · Thomas Lapole¹



Strength gains after local vibration training



High-frequency (300 Hz) mechano-acoustic vibration



Souron et al., 2017 (EJAP)

TAKE HOME MESSAGE

Eur J Appl Physiol
DOI 10.1007/s00421-017-3688-8



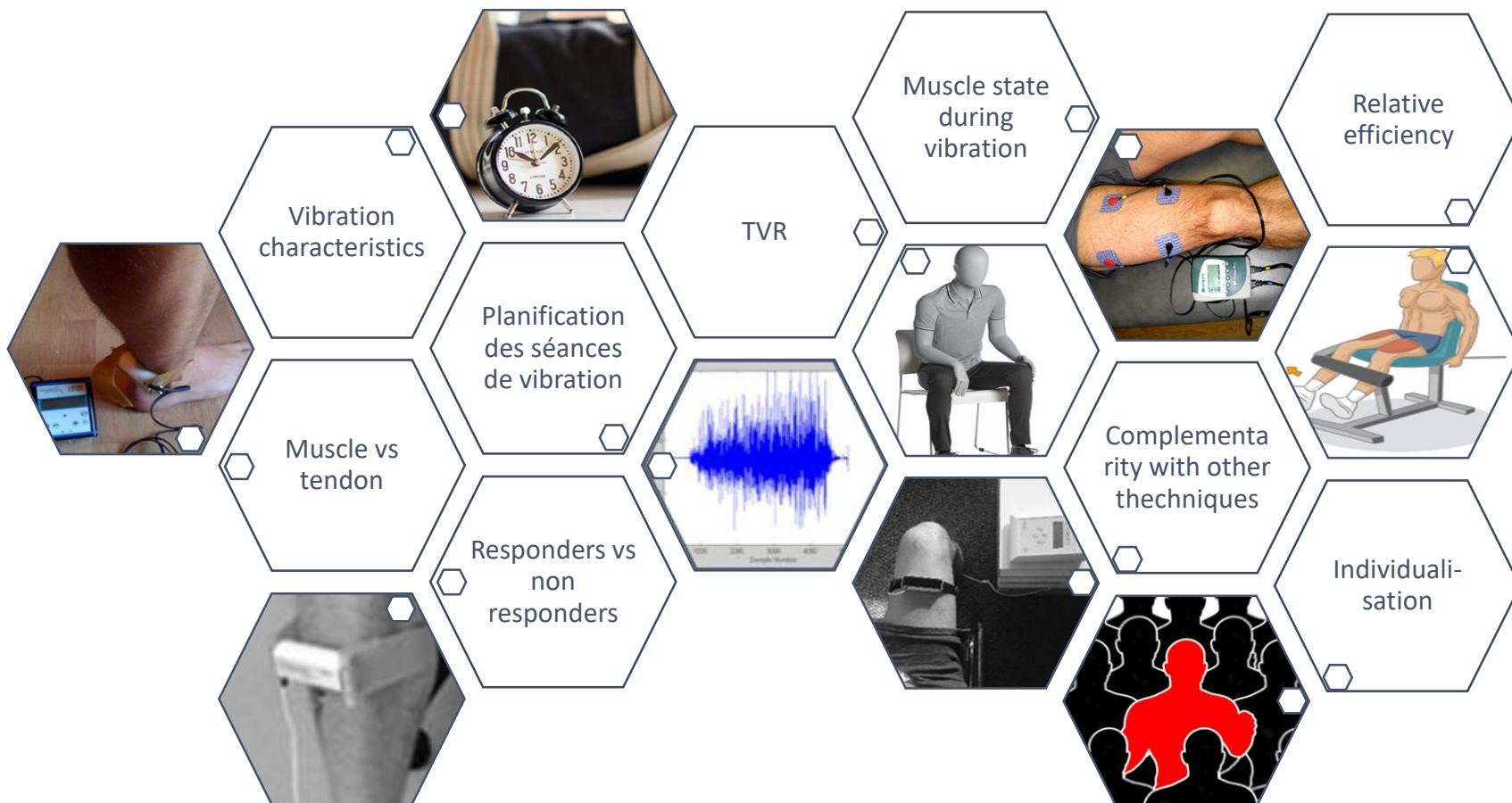
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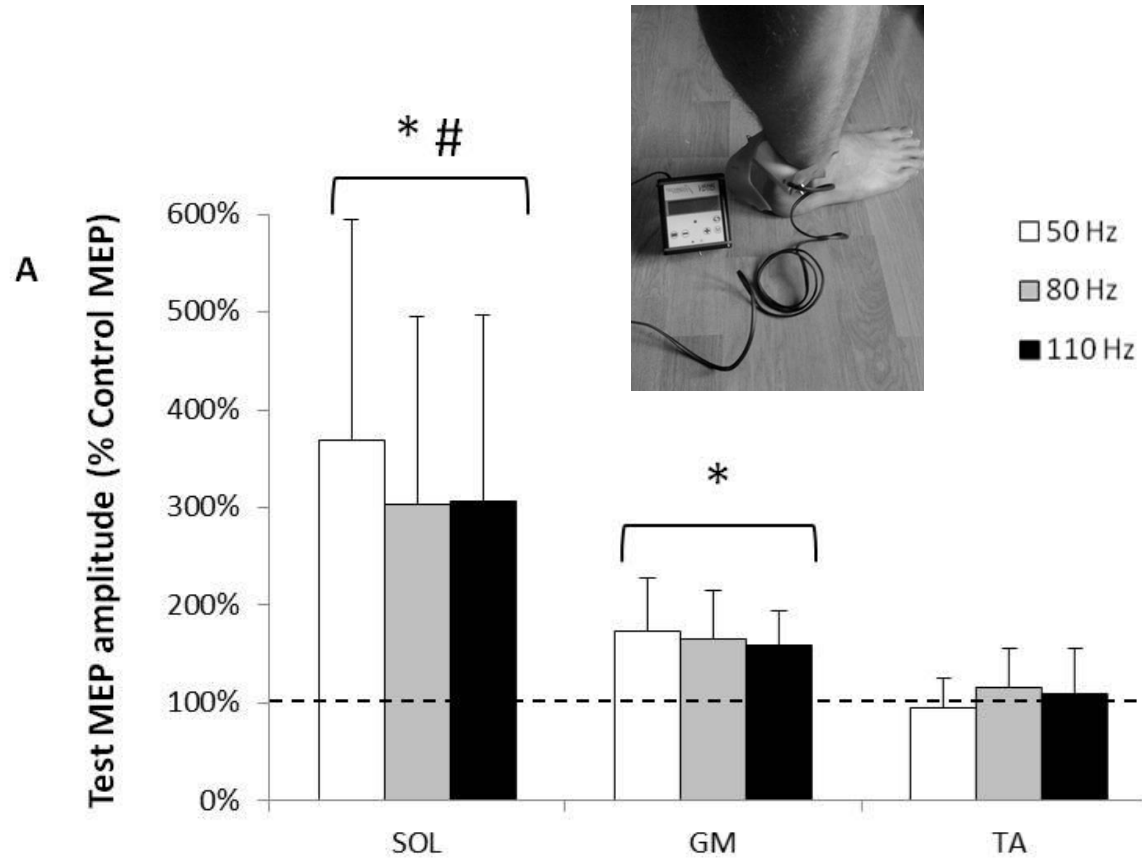
Robin Souron¹ · Thibault Besson¹ · Guillaume Y. Millet² · Thomas Lapole¹



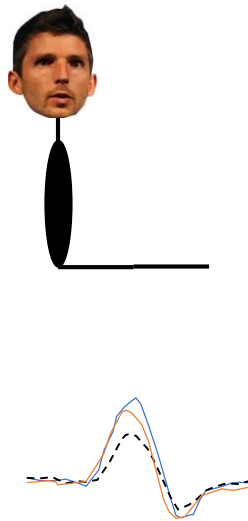
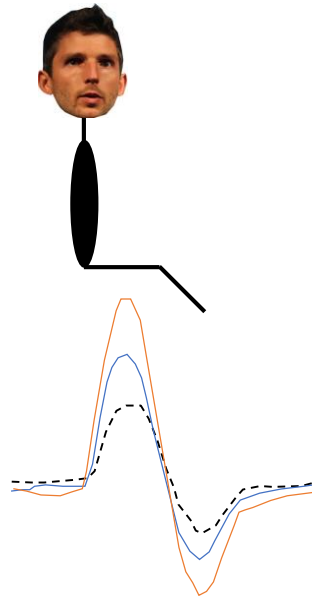
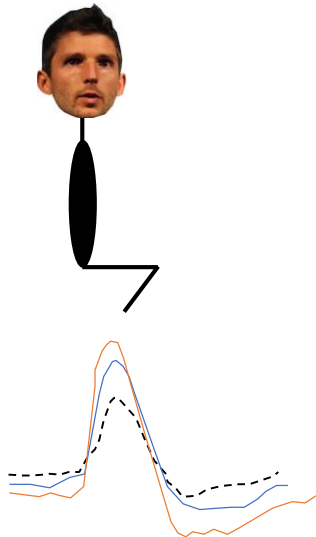
Can we propose recommendations for the use of local vibration ?



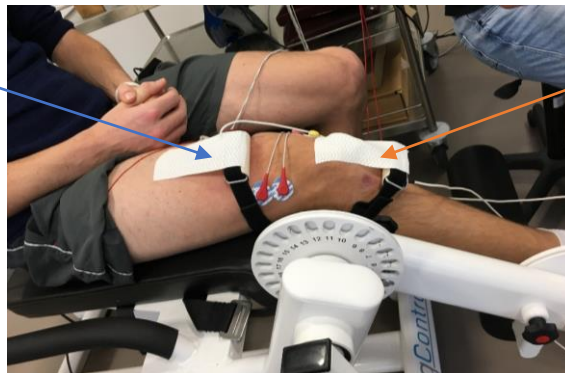
Can we propose recommendations for the use of local vibration ?



Can we propose recommendations for the use of local vibration ?



**Muscle
vibration**



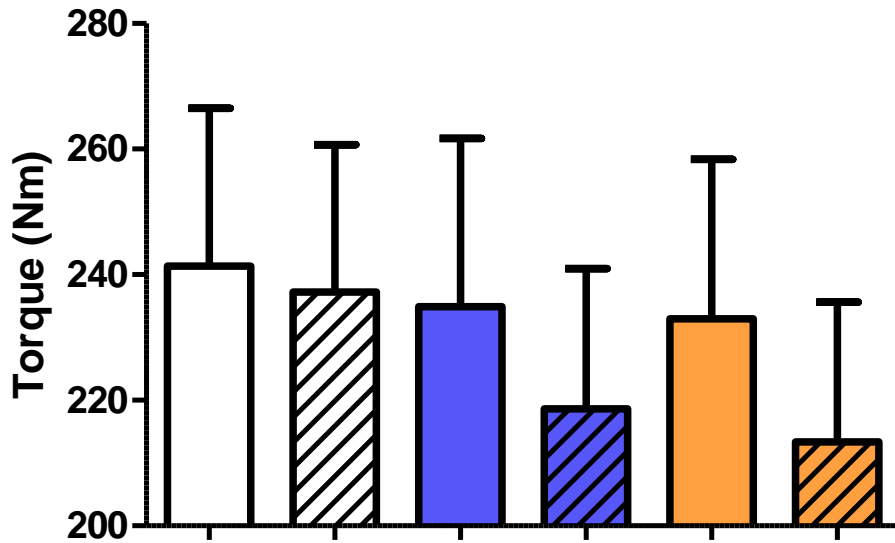
**Tendon
vibration**



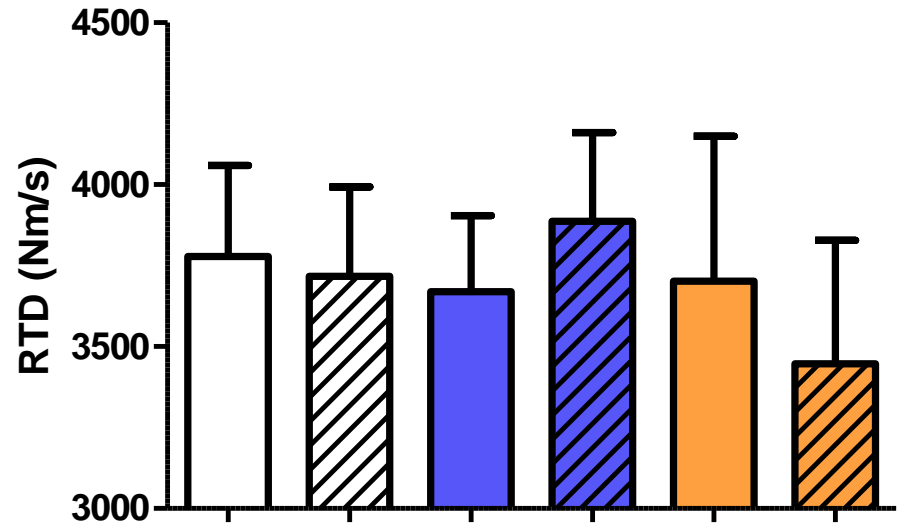
Can we propose recommendations for the use of local vibration ?

- PRE Cont
- ▨ POST Cont
- PRE Muscle
- ▨ POST Muscle
- PRE Tendon
- ▨ POST Tendon

MVC



RTD

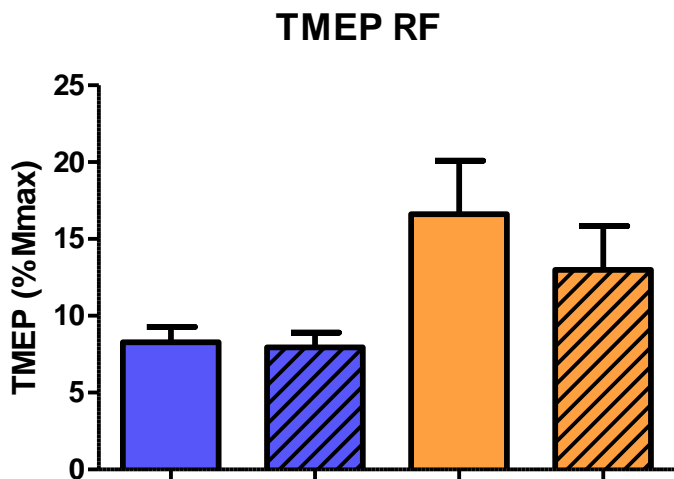
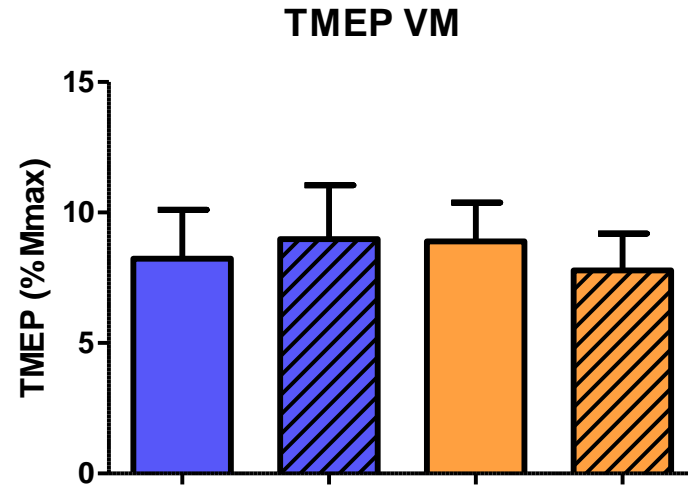
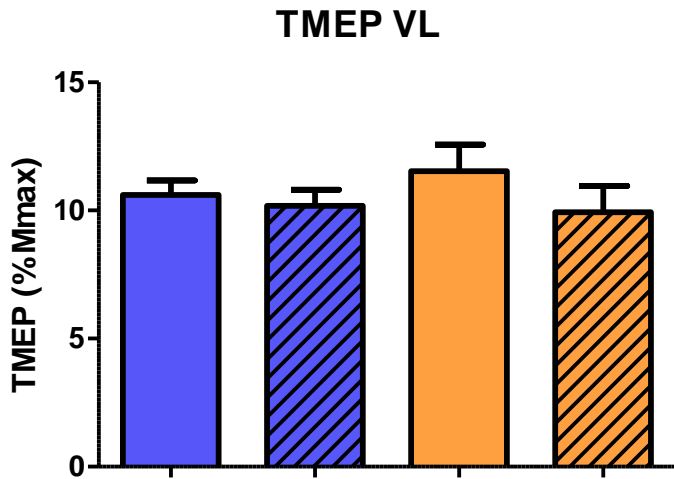


Muscle vibration



Tendon vibration

Can we propose recommendations for the use of local vibration ?



- PRE Muscle
- POST Muscle
- PRE Tendon
- POST Tendon

Muscle vibration



Tendon vibration

TAKE HOME MESSAGE

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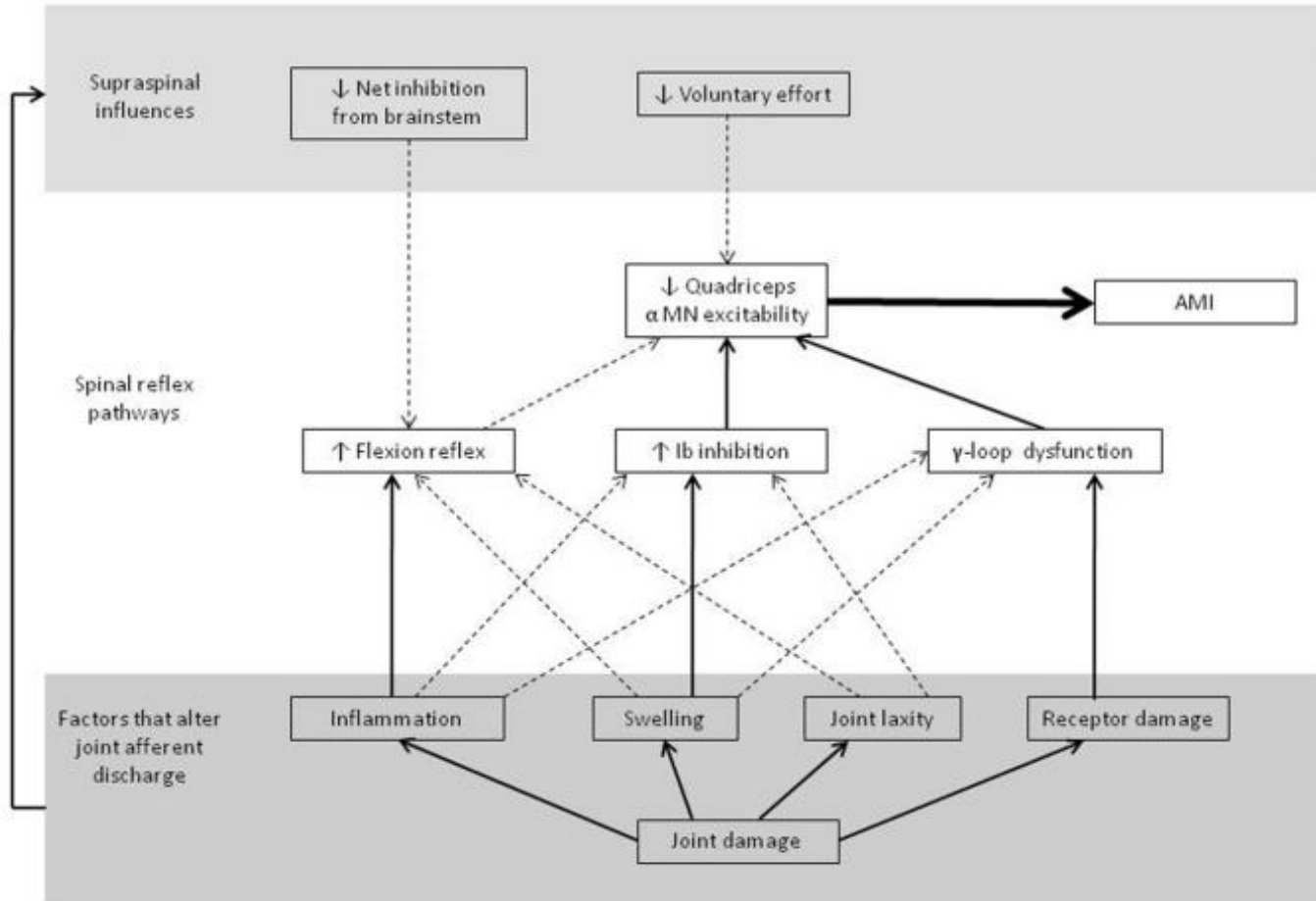
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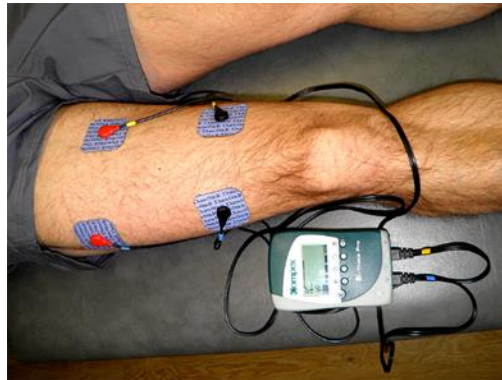
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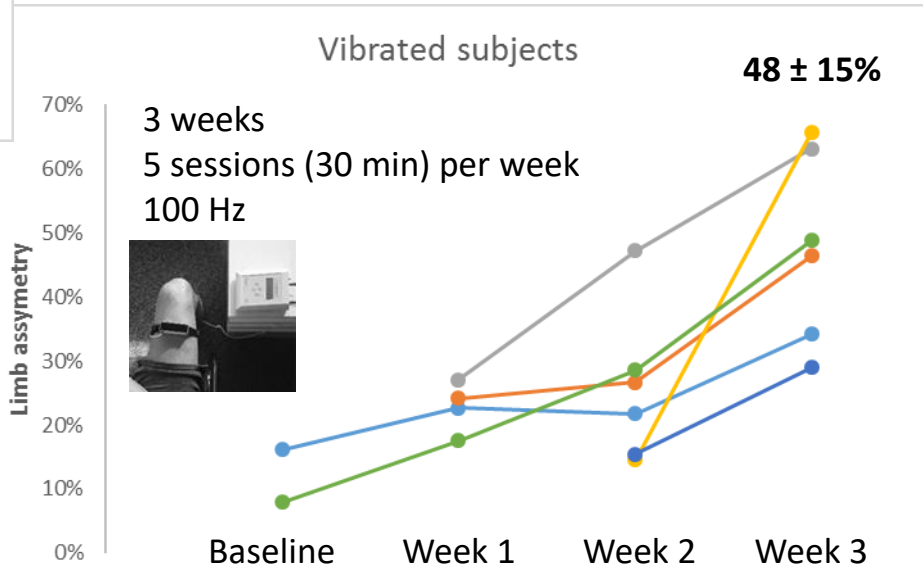
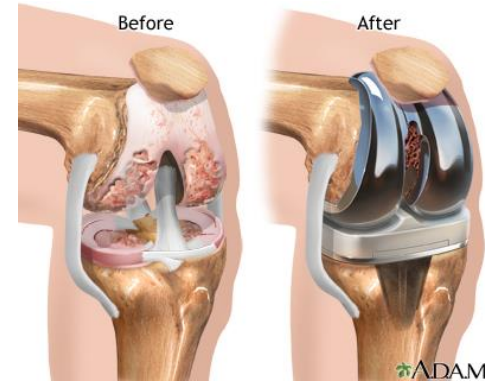
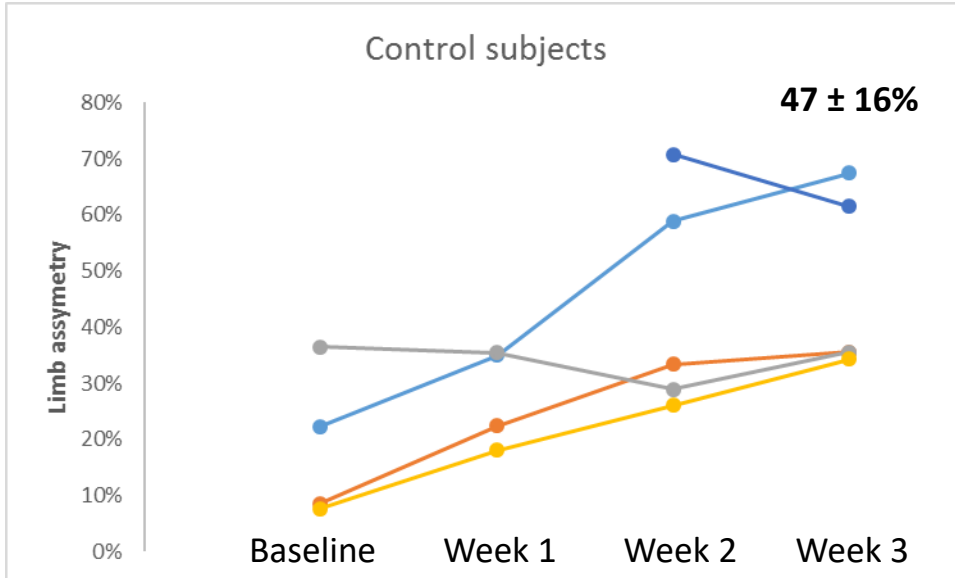
Arthrogenic muscle inhibition after knee surgery



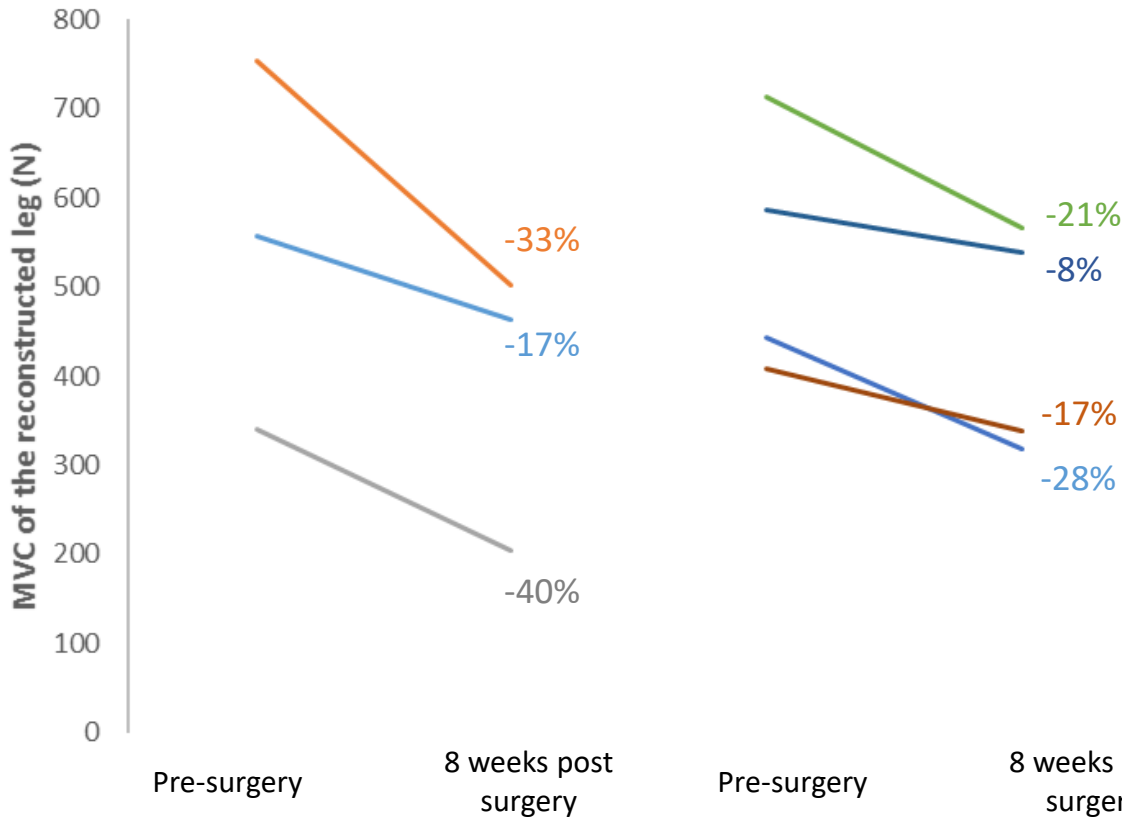
Rehabilitation after knee surgery



Chronic effects of local vibration on neuromuscular rehabilitation after total knee arthroplasty



Chronic effects of local vibration on neuromuscular rehabilitation after ACL reconstruction



LSI :

Control:
 $90 \pm 21\% \ggg 58 \pm 6\%$

Vibration:
 $94 \pm 15\% \ggg 74 \pm 6\%$

-30 ± 12%



Pre-surgery

8 weeks post surgery



-19 ± 8%





THANK YOU FOR YOUR ATTENTION



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