

# The Neuromuscular Basis for Stretching

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# Neuroanatomy

- *Afferent*- in going, sensory nerves.
- *Efferent*- out going motornerves.
- *Alpha-motorneurones*- motorneurones in anterior cord responsible for stimulation muscles.
- *Gamma- motorneurones*- motorneurones that supply muscle spindle fibres.

# Neuroanatomy comt.

## ■ Muscle Spindle

- Found in muscle
- Responds to stretch
- Causes excitation
- Stretch reflex loop
- Stretch reflex

(Barr and Kiernan 1988, Smith 1994)

# Neuroanatomy cont.

## ■ **Golgi Tendon Organ (GTO)**

- Found in tendons/ligaments
- Responds to stretch
- Causes inhibition
- Flexor reflex loop
- Inverse stretch reflex
- Autogenic inhibition

(Barr and Kiernan 1988, Smith 1994)

# Neuroanatomy cont.

## ■ Hoffman reflex (H-Reflex)

- Poorly described
- Occurs within alpha-motorneurone pool
- *Tests* measure alpha-motorneurone excitability

(Wilkinson 1992)

# Types of Stretching

- Ballistic
- Static
- Contract Relax
- Reciprocal Relaxation



# Ballistic Stretching

- Momentum
- Stimulates stretch reflex
- Movement too large for any effect
- Stretch occurs
- Support????

(Smith 1994, Wilkinson 1992)

# Static Stretching

- Slow speed
- No effect of on muscle spindle
- Possible effect on GTO
- Literature support for ↓ EMG output
- 15 seconds best timing

(Moore and Hutton 1980, Wilkinson 1992)



# Contract Relax Stretching

- Muscle on stretch with max vol contraction
- Increase tension in GTO
- Inhibition of stretch reflex
- Stimulation of inverse stretch reflex
- Result → autogenic inhibition

(Wilkinson 1992)

# Contract Relax Stretching<sub>cont.</sub>

- Timing??
- Post tetanic potentiation
  - » increase in EMG activity post stretch
  - » 10-20 secs post contraction
  - » lack of GTO inhibition
  - » transmitter remnants

(Hutton 1992, Wilkinson 1992)

# Reciprocal Relaxation Stretching

- 40% contraction of agonist at end range
- Theory of *Reciprocal Inhibition*
  - » Renshaw cells inhibit alpha-motoneurone pool
- Evidence
  - » high levels of EMG in antagonist
  - » not corresponding rise in H-reflex though
  - » most effective to gain length (Moore and Hutton 1980)

# Summary

- Neuroanatomy
- Types of stretching
- Theories driven by hypotheses
- More research



# References

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