The motor unit; anatomy and physiology

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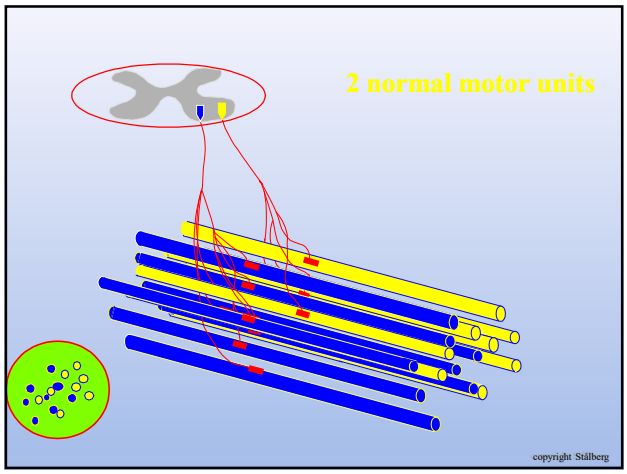
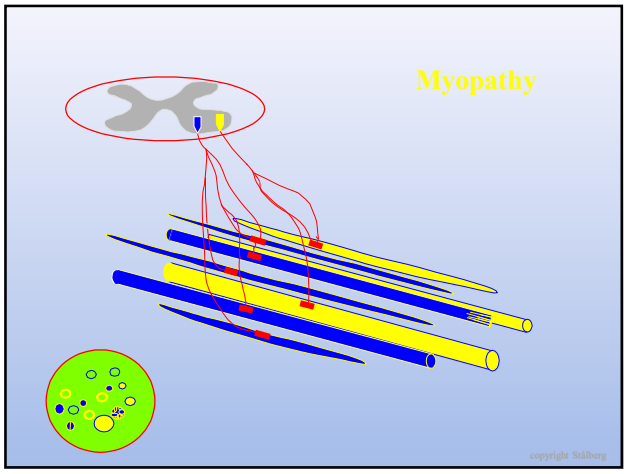
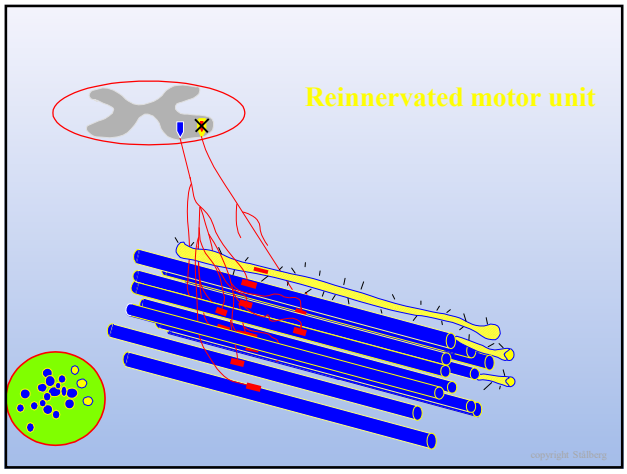
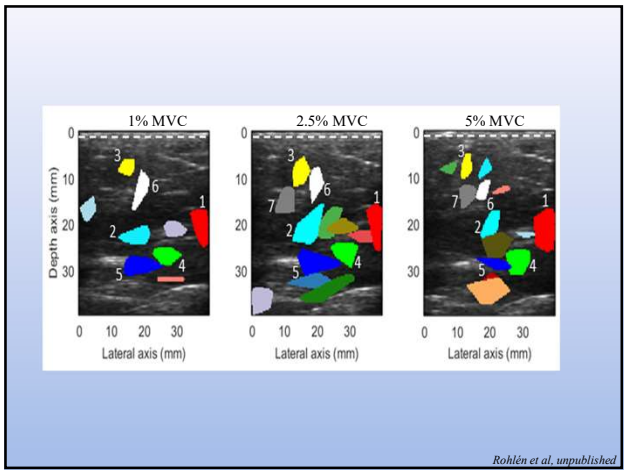
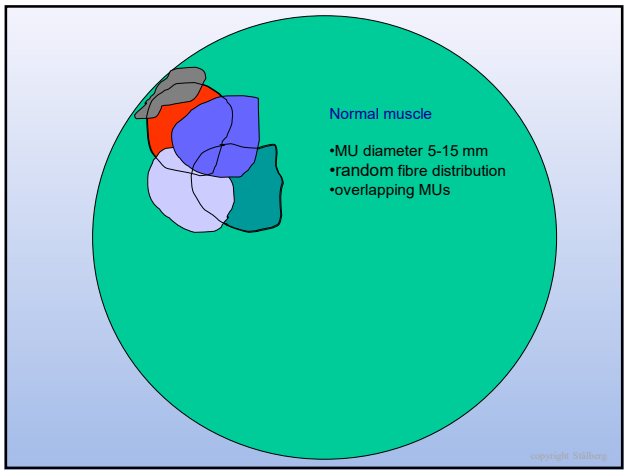
No conflict of interest

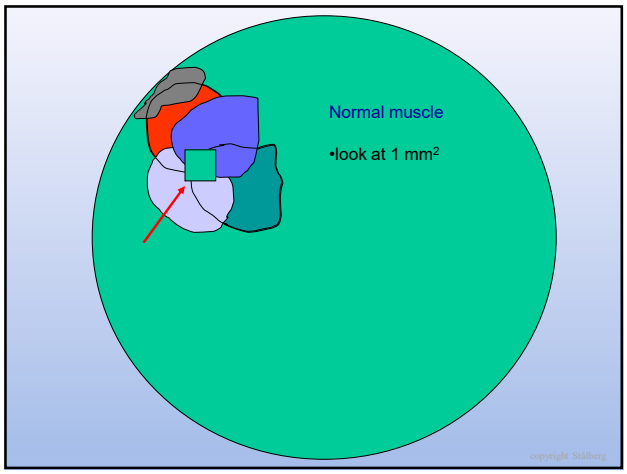


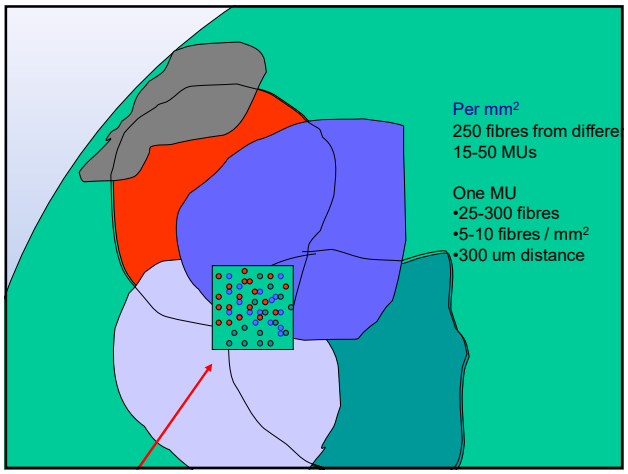








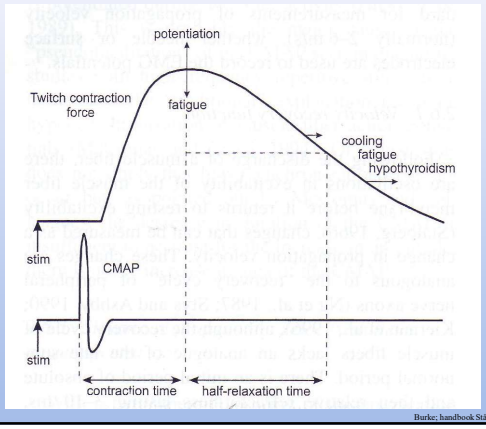




Parameters of normal motor units in limb muscles

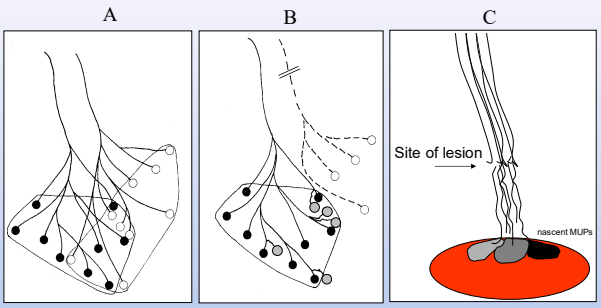
Muscle fibre	
histochemistry, metabol.	Same for all fibres in a given MU
type I	slow, aerobic, fatigue persistent
type II (A,B,X)	fast, anaerobic, fatiguing
fibres size	5-90 (50 um)
# motor end-plates	1 (1% of fibres have two)
Motor unit	
width of end-plate band	5 mm
distance between fibres	300 um
# fibres/MU	20-500 (100-200)
territory	2-15 mm (10 mm)

Twitch contraction and its changes



Burke; handbook Stålberg, 2003

The motor unit in reinnervation

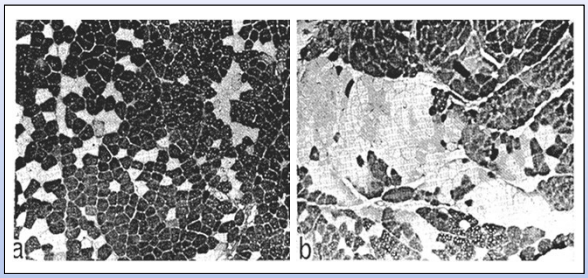


2 normal motor units

after partial denervation
collateral reinnervation

after complete denervation
nerve regeneration

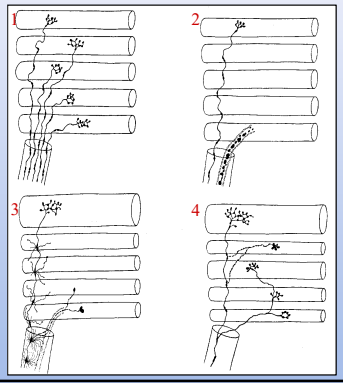
Grouping after partial denervation in rats



Anterior tibial muscle reinnervated, following root section, by collaterals from intact nerve fibres.
*Rat 13. a: moderate denervation after **L5 motor root section**, showing part of one motor unit of 454 fibres with some grouping.*
*Rat 16. b: severe denervation after **L4 motor root section**, showing part of one motor unit of 551 fibres, for the most part with compact distribution.*

E Kugelberg et al 1970

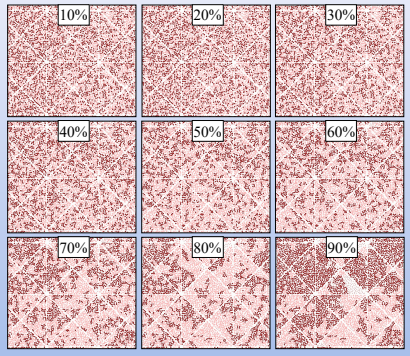
Diagrams showing collateral sprouting after partial denervation



1. Normal
2. Partial degeneration
3. Early sprouts
4. Collateral sprouting

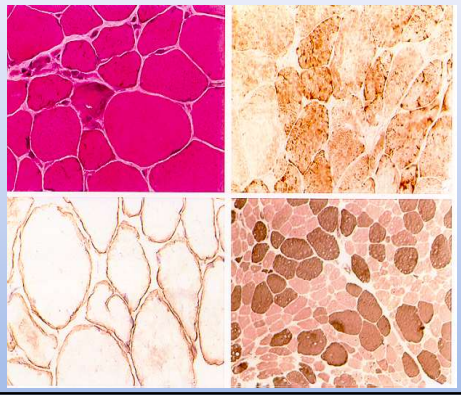
Coërs and Woolf 1959

Visual inspection of axonal loss

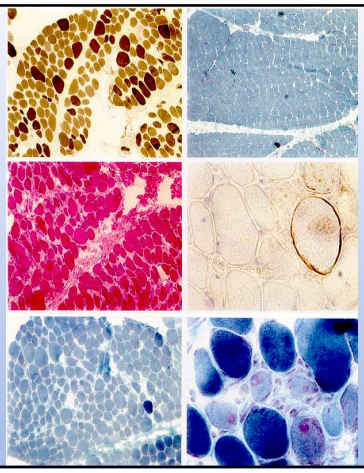


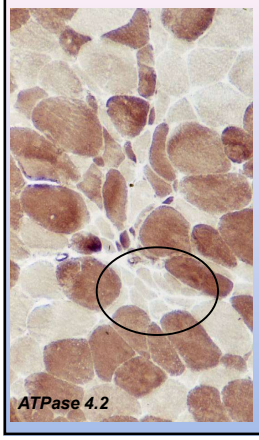
Stålberg, Karlsson

Myopathy



Duchenne

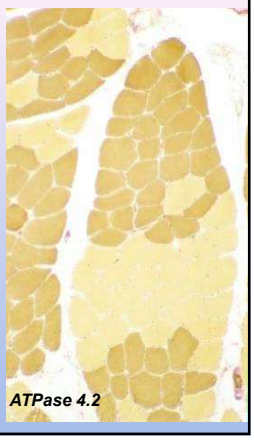




◄ *ALS: group atrophy and fiber type grouping.*

Healed neurogenic disorder: ► Fiber type grouping with normal size fibers

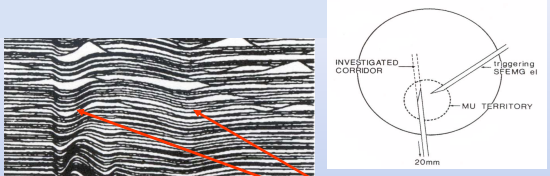
The changes in the biopsy most often do not reveal the etiology of the neurogenic disorder.

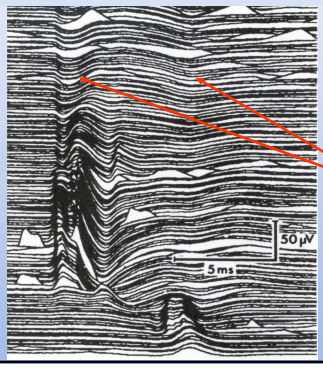


Scanning EMG

Temporal and spatial analysis of the MU

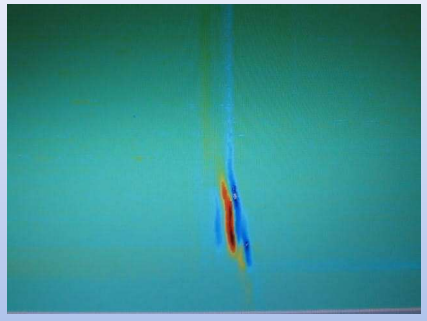
Scanning EMG





Signals from cannula

Scanning EMG, normal biceps



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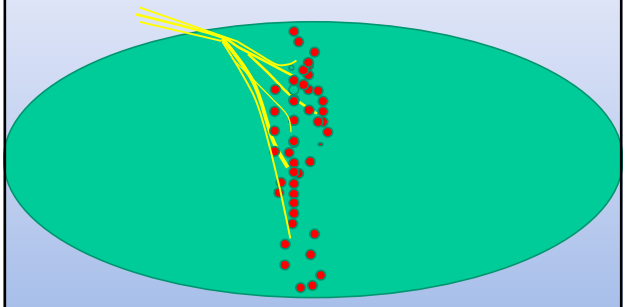
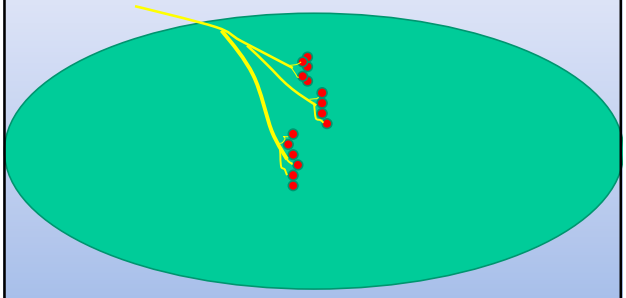
End-plate zone – all MUs



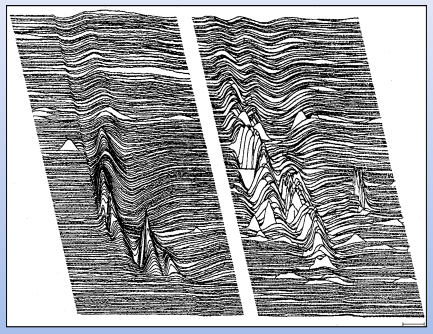
End-plate zone of one MU– fractions in Scanning EMG



Scanning EMG

Normal

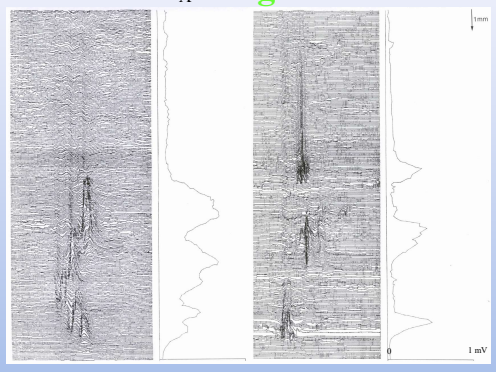
MND



TA muscle

2 ms

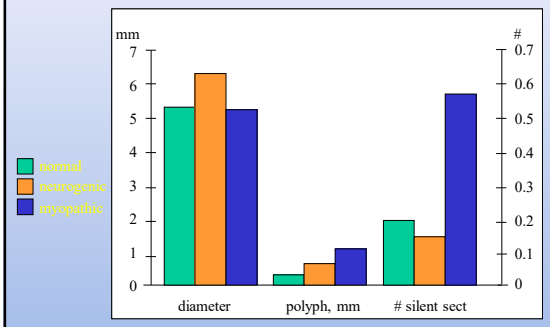
Scanning EMG



Normal Muse dystr

Scanning EMG

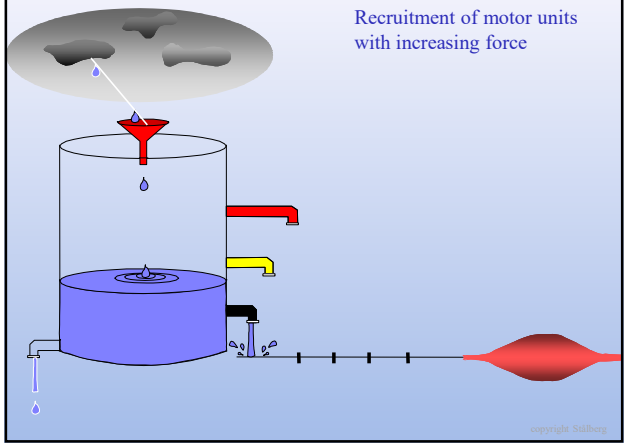
tibial anterior muscle



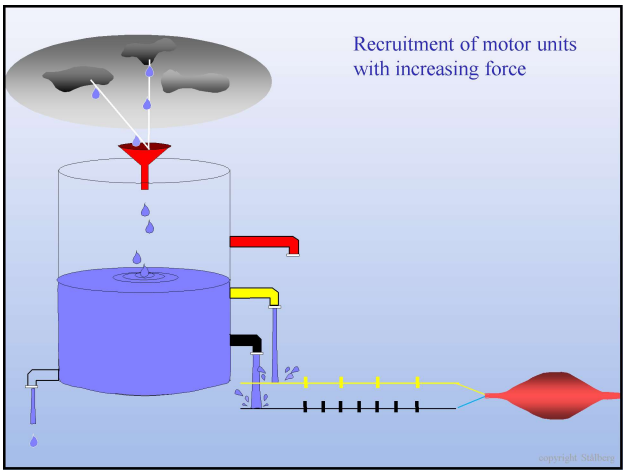
Dioszeghy, Stålberg

Physiology

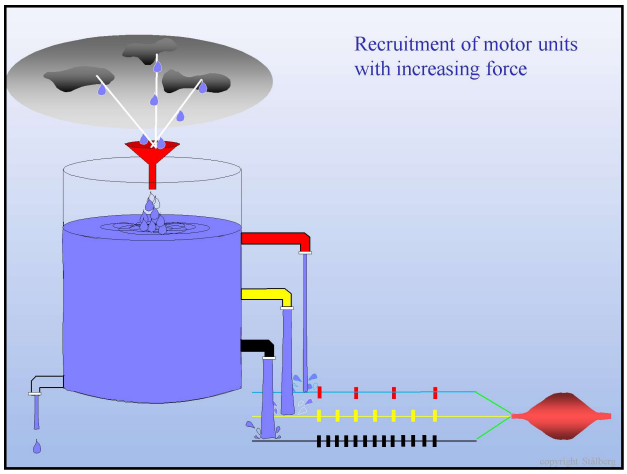
Recruitment of motor units with increasing force



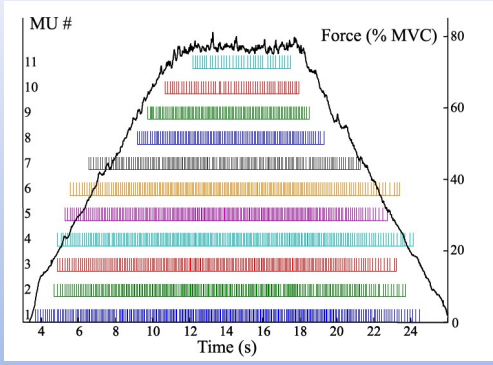
Recruitment of motor units with increasing force



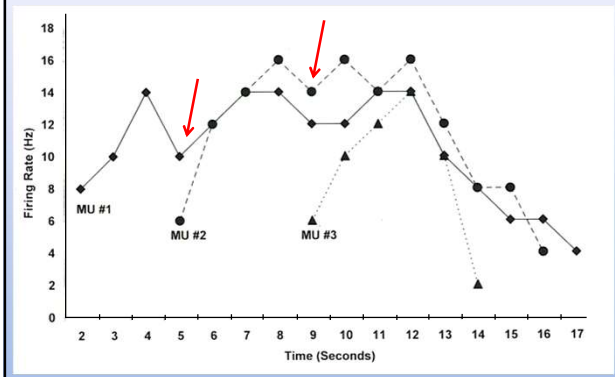
Recruitment of motor units with increasing force

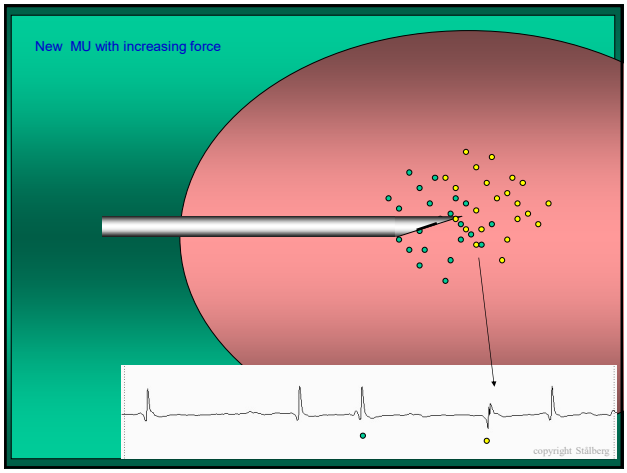


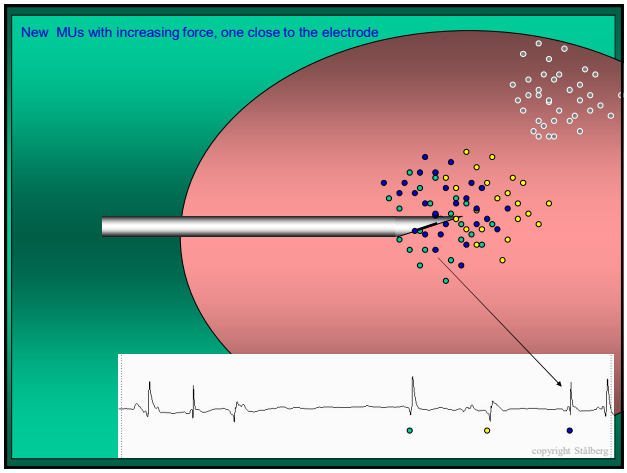
Vastus Medialis

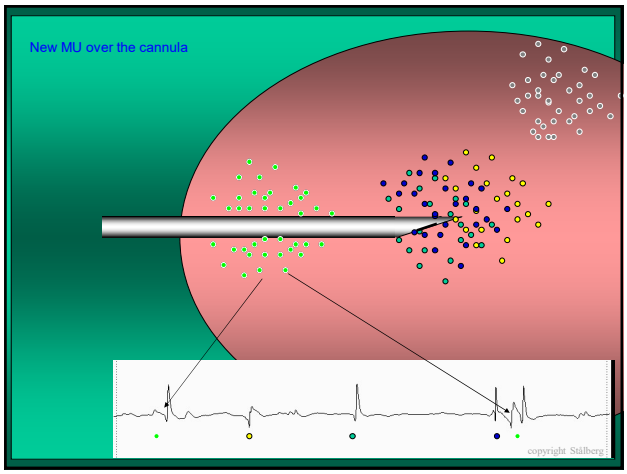


Precision Decomposition



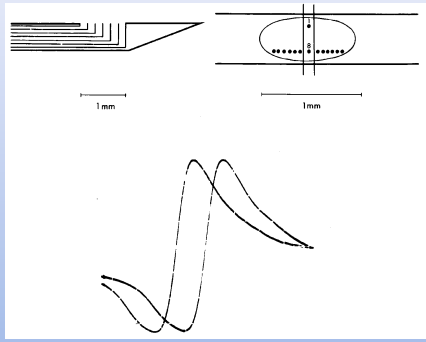




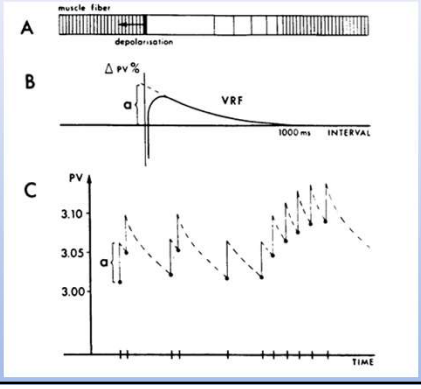


Propagation velocity along a single muscle fiber

Multielectrode measurement of propagation velocity in a single musle muscle fiber

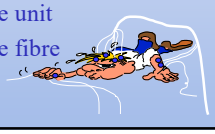


Velocity recovery function, VRF double stimulation



Electrophysiological methods to study the Motor Unit

- Structure
  - anterior horn cell
  - nerve
  - n-m junction
  - muscle unit
  - muscle fibre
- Method
  - reflexes, firing pattern
  - conduction studies microneurography MUNE
  - SFEMG, rep stim
  - EMG, twitch
  - SFEMG



Comparison of electrophysiological parameters

Parameters	nm-j	myopathy	den/reinn	axon loss	CB	central
SFEMG	↑	↑	↑	n	n	n
Conv MUP	abn	↓	↑	n	n	n
Conv IP	n	myo	neur	↓	↓	↓
Macro	n	↓ n	↑	n	n	n
MUNE	n	n	n	↓	n	n
TMS	n	n	n	↓	↓	abn

Thanks for listening