The Integration of Neurography and EMG

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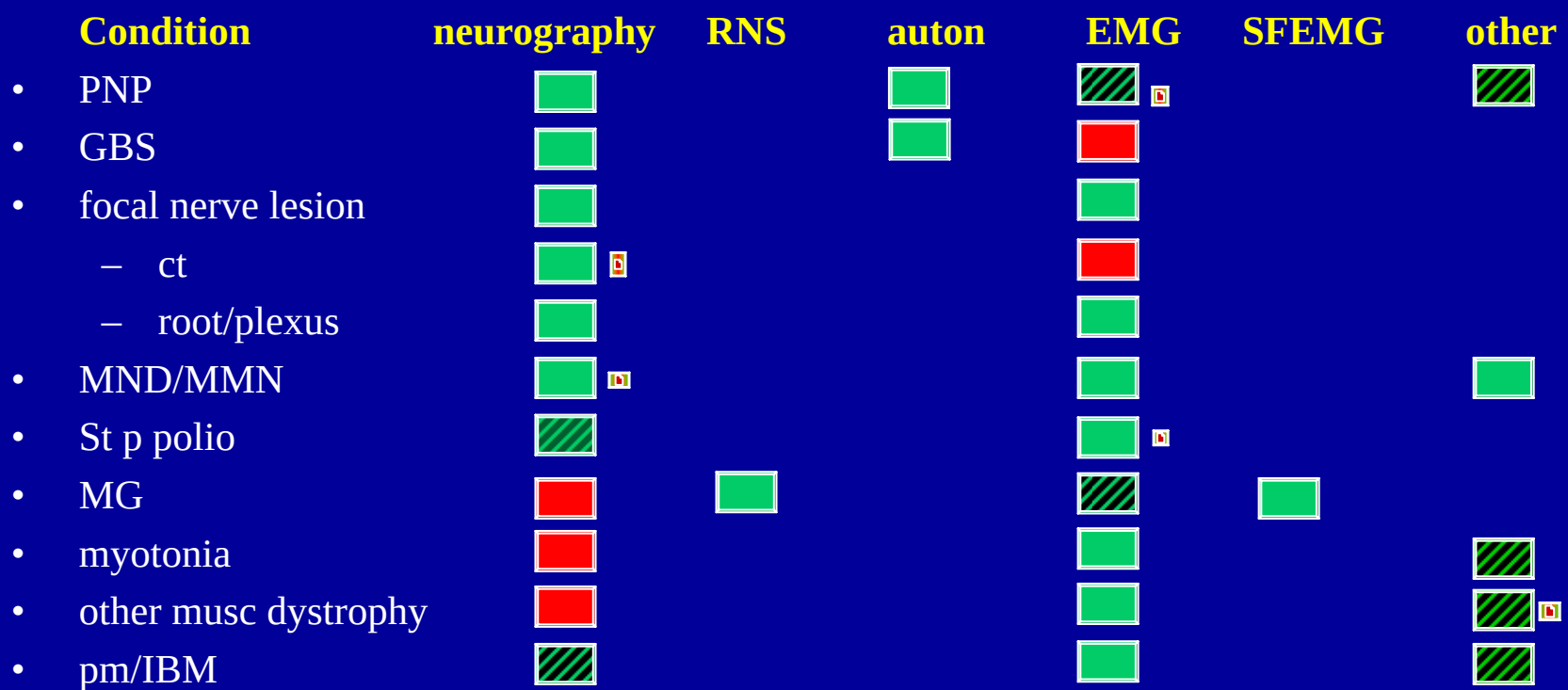
Neurography and EMG, the integration



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Place of EMG

1. Ways to express EMG abnormality
2. MUP and IP analysis
3. Neurography and EMG, integration

What do we want to express

- Muscle membrane function - spontaneous
- Muscle fibre characteristics; diameter
- MU organisation
  - number of fibres
  - grouping
- N-M transmission
- # motor units
  - total
  - activation; pattern, fullness

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Neurography in muscle disorders

- Indications
  - concomitant neuropathy? (mitochondr, pm, paramalignancy, secondary entrapment)
  - use CMAP to assess muscle bulk

Neurography in MND/MMN

MND:

Exclude axonal neuropathy

Confirm normal SCS

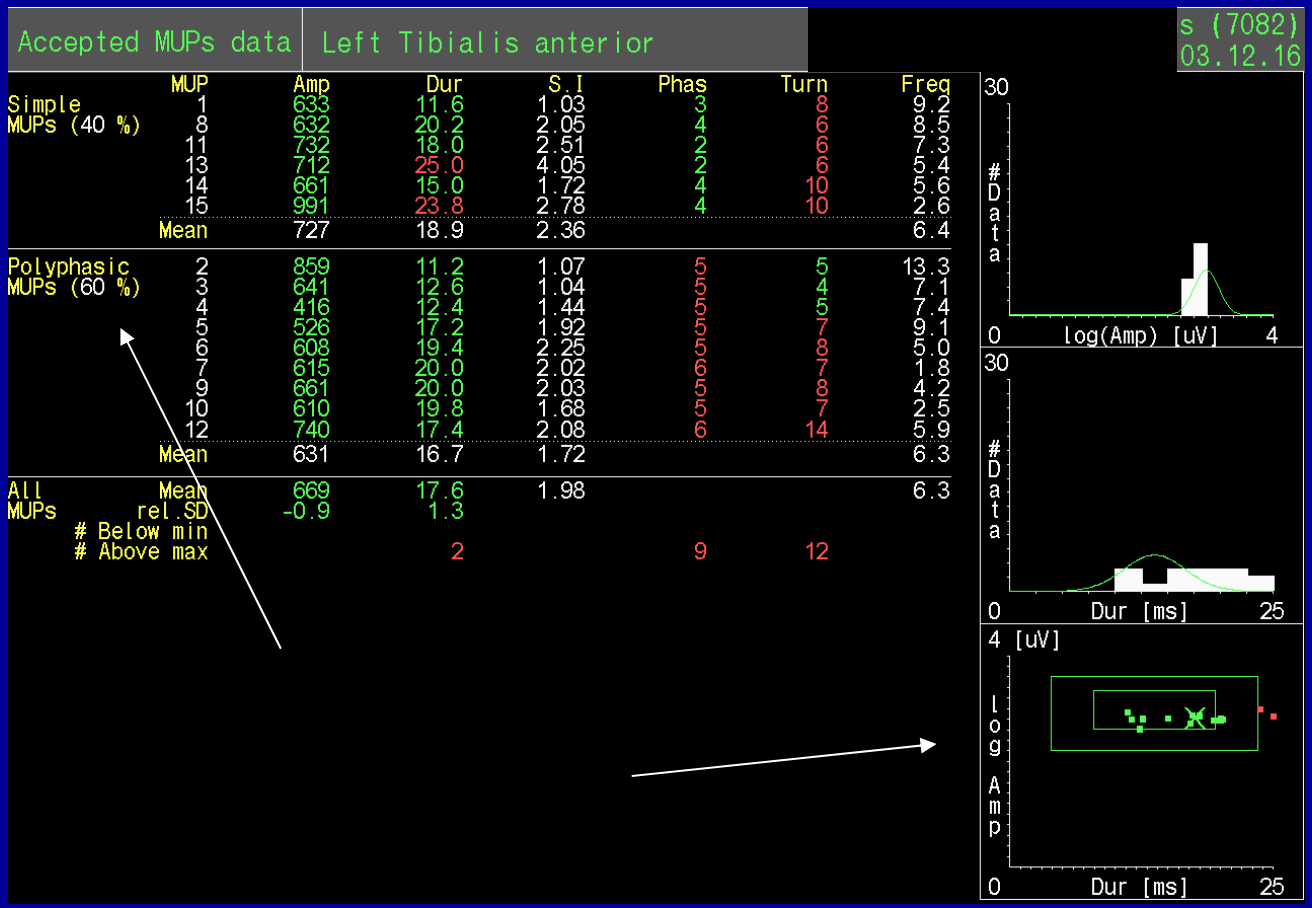
Exclude MMN

MMN:

Demonstrate motor cond block in individual motor nerves

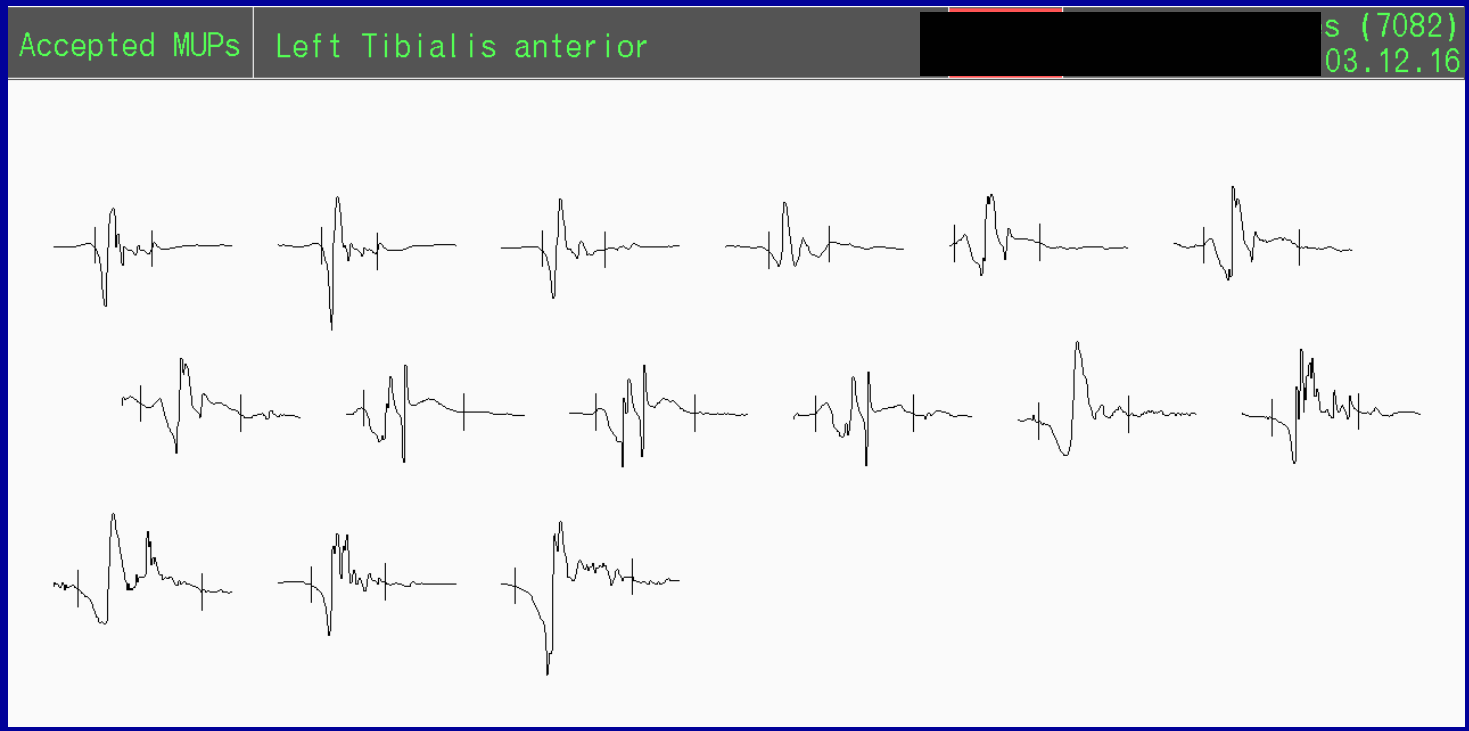
Confirm normal SCS

EMG in pnp

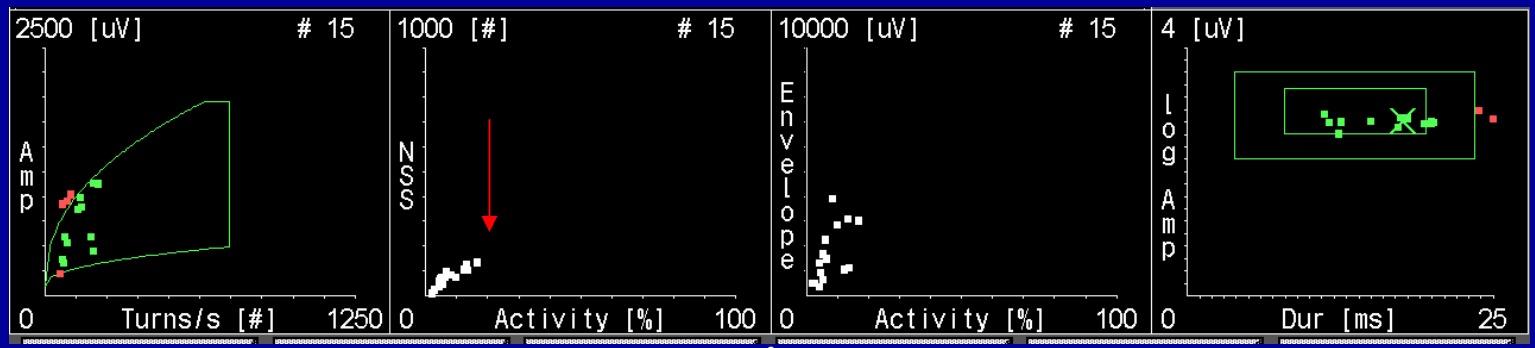

Accepted MUPs data
Left Tibialis anterior
s (7082)
03.12.16
MUP Amp Dur S.I Phas Turn Freq
Simple MUPs (40 %)
1 633 11.6 1.03 3 8 9.2
8 632 20.2 2.05 4 6 8.5
11 732 18.0 2.51 2 6 7.3
13 712 25.0 4.05 2 6 5.4
14 661 15.0 1.72 4 10 5.6
15 991 23.8 2.78 4 10 2.6
Mean 727 18.9 2.36 6.4
Polyphasic MUPs (60 %)
2 859 11.2 1.07 5 5 13.3
3 641 12.6 1.04 5 4 7.1
4 416 12.4 1.44 5 5 7.4
5 526 17.2 1.92 5 7 9.1
6 608 19.4 2.25 5 8 5.0
7 615 20.0 2.02 6 7 1.8
9 661 20.0 2.03 5 8 4.2
10 610 19.8 1.68 5 7 2.5
12 740 17.4 2.08 6 14 5.9
Mean 631 16.7 1.72 6.3
All MUPs Mean 669 17.6 1.98 6.3
rel.SD -0.9 1.3
Below min
Above max 2 9 12
30
Data
0
log(Amp) [uV]
4
30
Data
0
Dur [ms]
25
4 [uV]
Log Amp
0
Dur [ms]
25

EMG in pnp, MUP summary

MUP



IP



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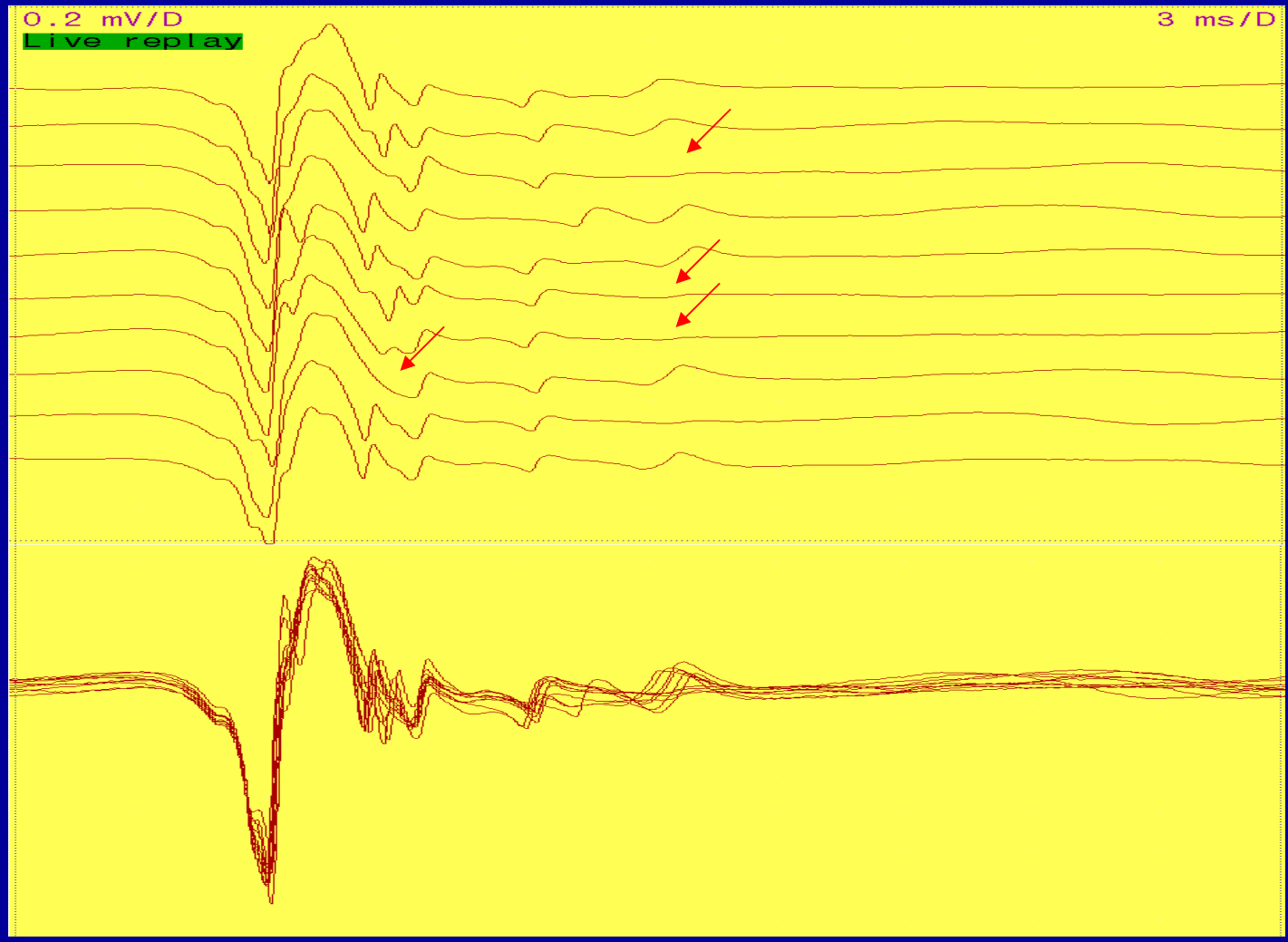
EMG in pnp, jiggle + poly



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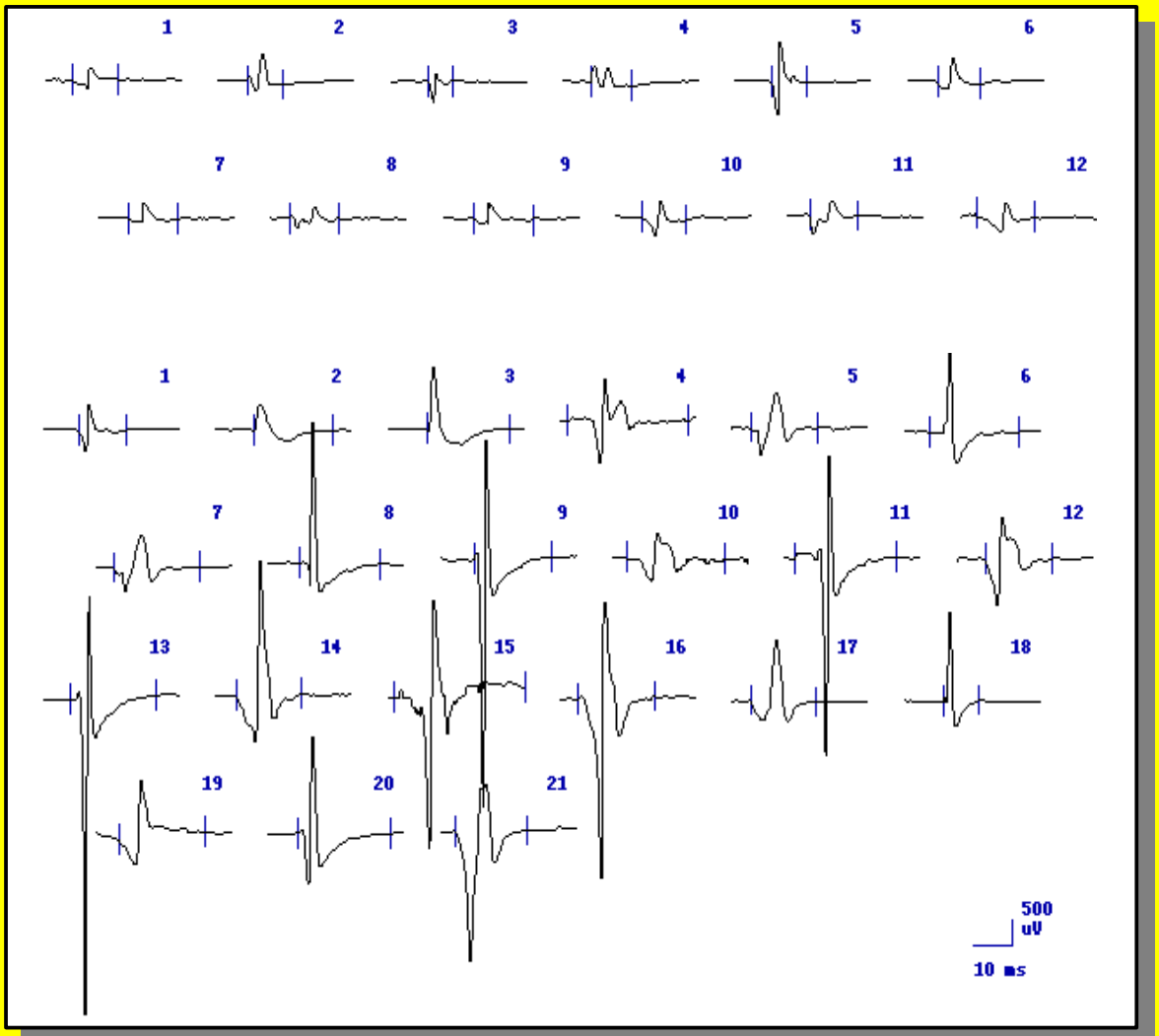
EMG in St p polio



Normal

Polio

Vast lat

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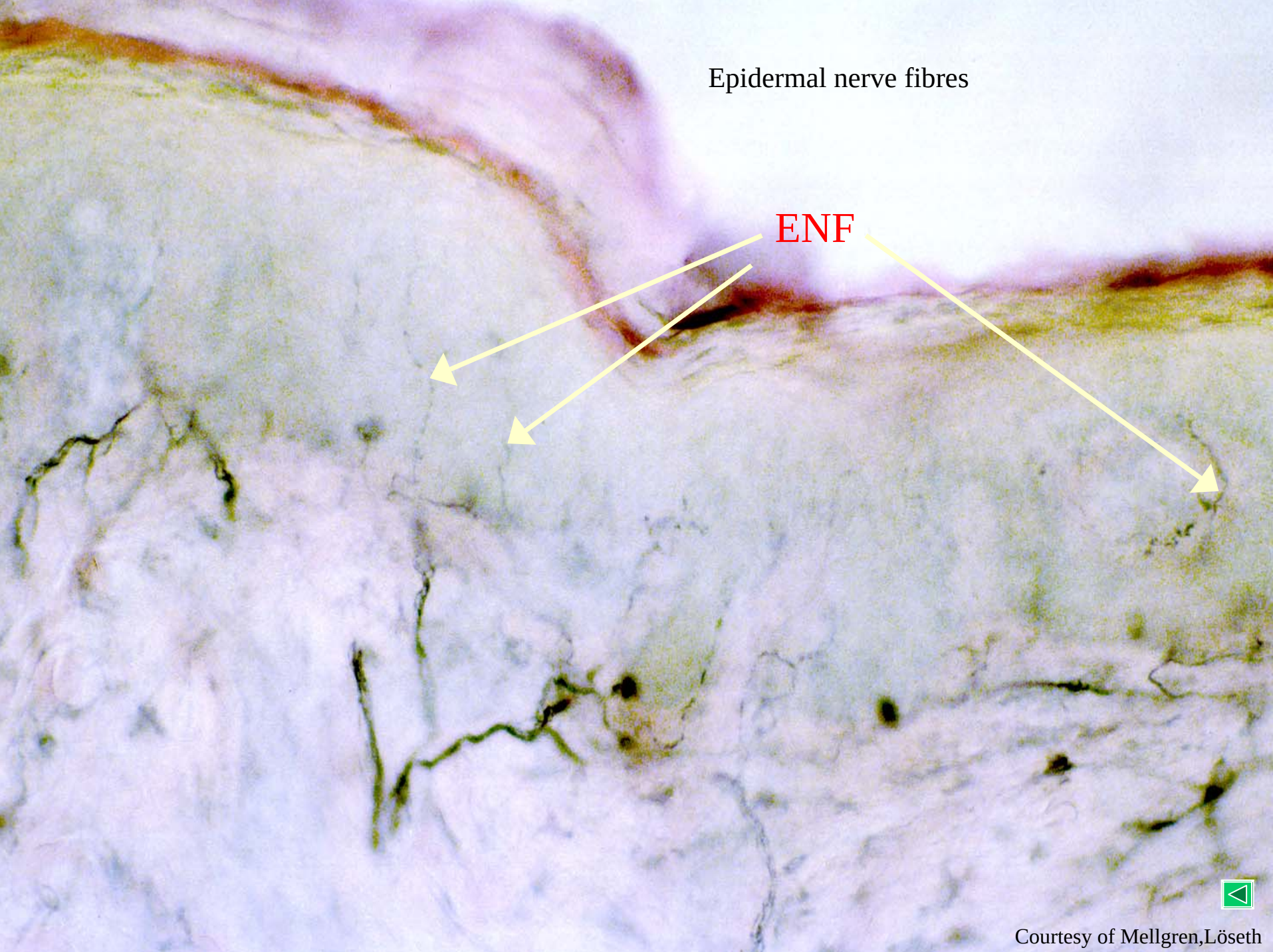
Small fiber testing

- Autonomic test (RR,SR)
- Epidermal nerve fiber density 
- Thermotests
- Near nerve needle neurography
- Microneurography
- Special neurography methods



Courtesy of Mellgren,Löseth

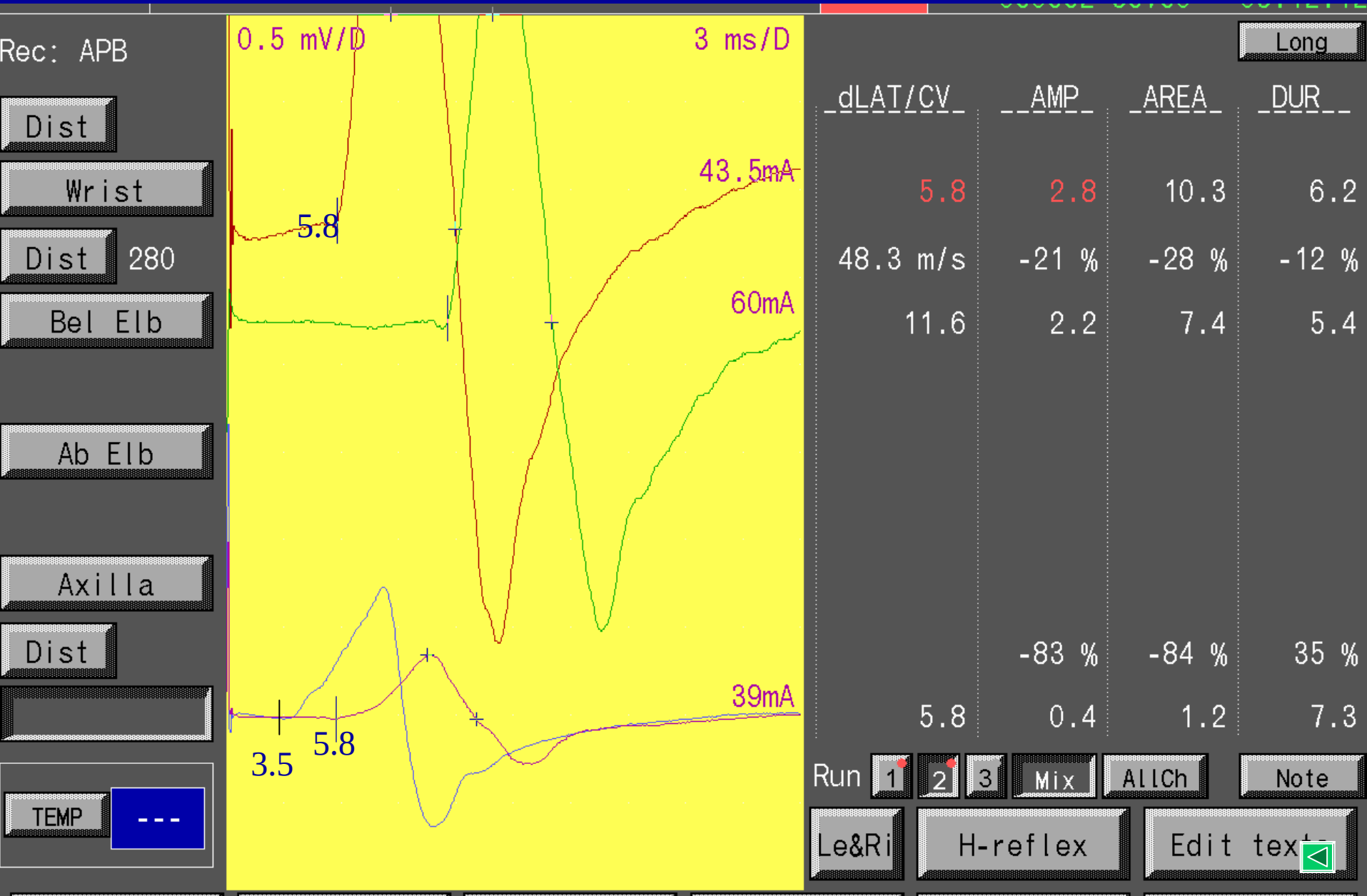
Other investigations for muscle

- CK
- Muscle biopsy
  - morphology
  - histochemistry
  - electromicroscopy
  - metabolic factors
- Genetic studies
- MRI 
- CT
- Ultrasound

Other tests in MND

- **MUNE**
  - Reduced # MU should be assessed in MND, St p polio
    - electrical stimulation (incremental, dual stim sites, statistical)
    - voluntary (MUNIX)
- **TMS**
  - Excitability (threshold and PSTH)
  - CCT
  - TST

CTS, palmar inteross and 1st lumbrical



EMG in myotonia

- confirm myotonic discharges
- is EMG myopathic or not
- explore distribution (prox-dist)
- effect of temperature
- effect of activity

Neurography in St p polio

- No primary reason
- Atypical symptoms need further EDX
  - neuropathy (pnp, entrapment)

EMG in St p polio

- confirm neurogenic involvement
- find subclinical involvement
- assess degree of MU loss
- find other cause of symptoms:
  - entrapment, radiculopathy

Neurography in MG

- No primary reason for neurography
- Used when picture is atypical and when RNS and SFEMG are negative
- NOTE:
  - during any neurography low CMAPs should alert the examiner on nmj problems (remember to test facilitation in routine and in ICU)

SFEMG in MG

- assess increased jitter (same as jiggle in conc EMG)
- confirm normal FD

- not expected
  - increased FD (reinnervation)
  - normal jitter in 20/20 recordings

EMG in CTS

- EMG NOT necessary for the diagnosis *per se*. Neurographic methods are sensitive and specific.

- If EMG is used,
  - the question is to exclude roots; in Ext Carp Rad (C6) and EDC and Flex carp rad (C7)
  - in APB it may answer the question of amount of axonal lesion (but CMAP is usually better)

Autonomic tests, RR, SSR

- To assess involvement
  - in GBS may be vital
  - small fiber involvement
  - specific conditions, e.g. amyloidosis,

EMG in Musc Dystr

- Typical findings
  - spont activity
  - small polyphasic MUPs
  - early recruitment
  - dense or reduced IP (severity)
- Not expected
  - normal EMG - think of non dystrophic cond.
  - myotonia

Neurography in Musc dystr

- No primary reason for neurography

If performed:

- Expected findings
  - low motor ampl,
  - normal MCV
  - F waves low ampl, normal persistence
  - normal sensory ampl

- Not expected
  - abnormal neurography (think of mitochondial cond, paramalignant condition)

Neurography

- pathophysiology — demyelinating/axonal/CB
- fiber type — sensory/motor/autonomic
- fiber size — large/small
- distribution — distal/proximal
- severity

Neurography in GBS

- demonstrate acute motor and sensory neuropathy
- demonstrate conduction block
- assess: severity, pathology, distribution

Neurography in root/plexus

- Sensory (with sensory symptoms)
  - normal distal amplitudes - root or CB anywhere
  - reduced distal ampl - axonal plexus involvement

- Motor (with weakness)
  - reduced distal amplitudes - axonal lesion
  - normal amplitudes - CB

Neurography in focal lesion

Motor symptoms:

– pathophysiology and severity

- demyelinative or CB — focal testing (SSS)
- axonal — SSS may not help, go to EMG

Sensory symptoms:

- low distal amplitudes — go to other nerves, + EMG
- normal distal ampl — find focus (if not, make SEP)

Neurography in CTS

- to assess:
- pathophysiology:
  - demyelination — latency
  - axonal — distal ampl
  - CB — block across ligament
- fiber type
  - sensory/motor
- severity

CTS severity

- very slight — only relative abnormality
  (other nerves; uln mot, uln sens, rad sens)
- slight — only sensory abnormaly
- moderate — sens + motor
- severe — no sens resp, motor abnormality
- very severe — no responses

EMG in GBS

- **EMG in Early phase:**
  - No indication
  - MUNE (but only MUNIX which includes voluntary act)

- **EMG in Late phase:**
  - degree of axonal involvement
  - jiggle
  - IP
  - Macro

EMG in MG

- No indication in diagnostic work up
- If SFEMG is neg, EMG is indicated to find alternative diagnosis to MG

EMG in MND

- To confirm
  - generalized denervation
  - fasciculations
- To exclude myopathy

EMG in MMN

- To demonstrate focal/multifocal denervation

Neurography in myotonia

- NCS is usually not necessary when EMG has confirmed myotonia
- When myotonia is suspected, it is wise to start with EMG

RNS in MG

- Least sensitive method. If this is pos. and typical, MG is highly suspected.
  - proximal muscles
  - no treatment
  - warm muscle
- exclude (think of…)
  - LEMS, myotonia, Mc Ardle, cong MG

EMG in PM/IBM

- Expected positive findings
  - myopathy
  - spont. activity (fib, CRD) (th. paraspinals)
- Not expected
  - normal EMG
  - neurogenic pattern (except in end stage)
  - myotonia

EMG in focal nerve lesions

- Localize site
  - pure axonal focal lesion cannot be defined with neurography
  - root lesions (involvement of post rami= root, ant rami for segment)
- assess degree of axonal damage
- follow reinnervation (spont activity, conventional MUP parameters, jiggle, IP)
- MUNE/MUNIX

Why EMG in pnp

Not always necessary….but possible objectives are to:

- assess amount of axonal damage 
  - long nerves
- assess dynamics
  - jiggle
- assess distribution
  - distal/prox
  - asymmetric
- exclude other reasons of symptoms
  - distal myopathy
- find clue to underlying condition
  - neurotonia

Neurography in GBS

- confirm MOTOR-sensory demyelinating pnp
- confirm conduction block (MCS, F persistence)
- assess site (prox-dist --antiMAG)
- assess amount of axonal involvement (CAMP ampl)
- autonomic involvement

- NOTE:
  - CB due to high temperature
  - nerve hypoexcitability

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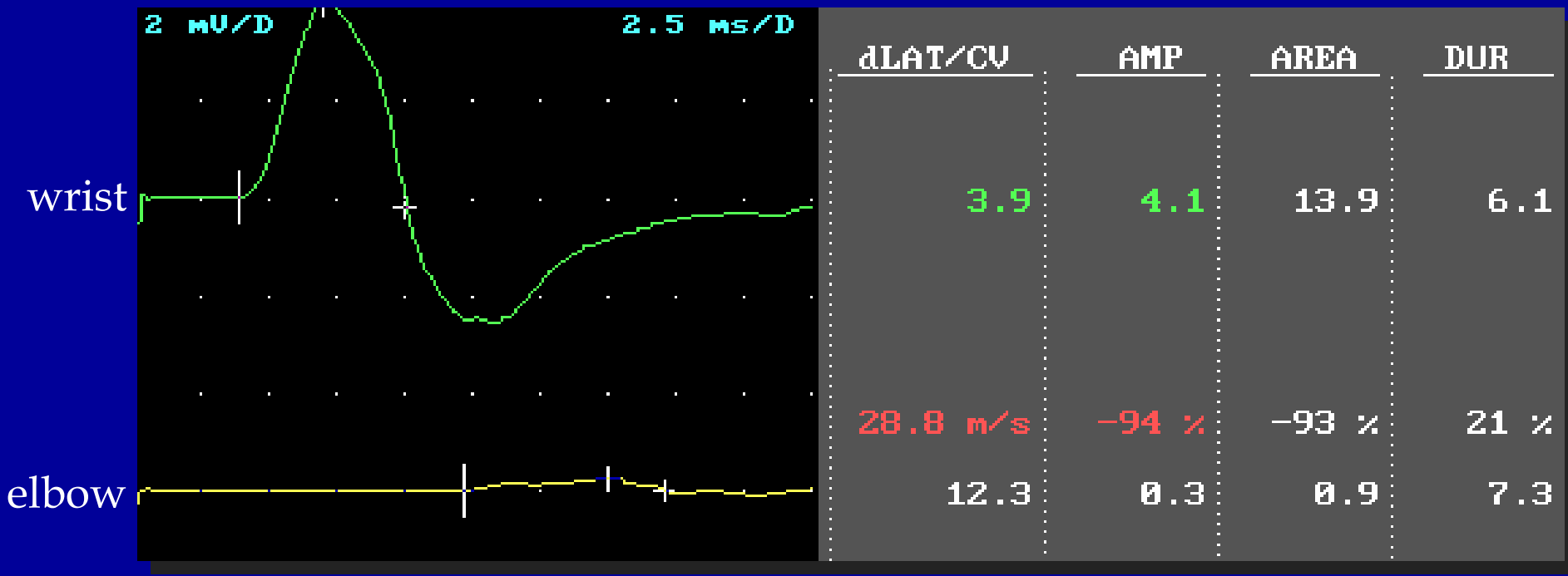
Distribution of conduction slowing

	proximal	even	distal
GBS	+		(+)
CIDP	+		
CMT1		+	
anti MAG			+

modified after Attrian et al. Clin neurophys March 2001

Conduction block in MMN



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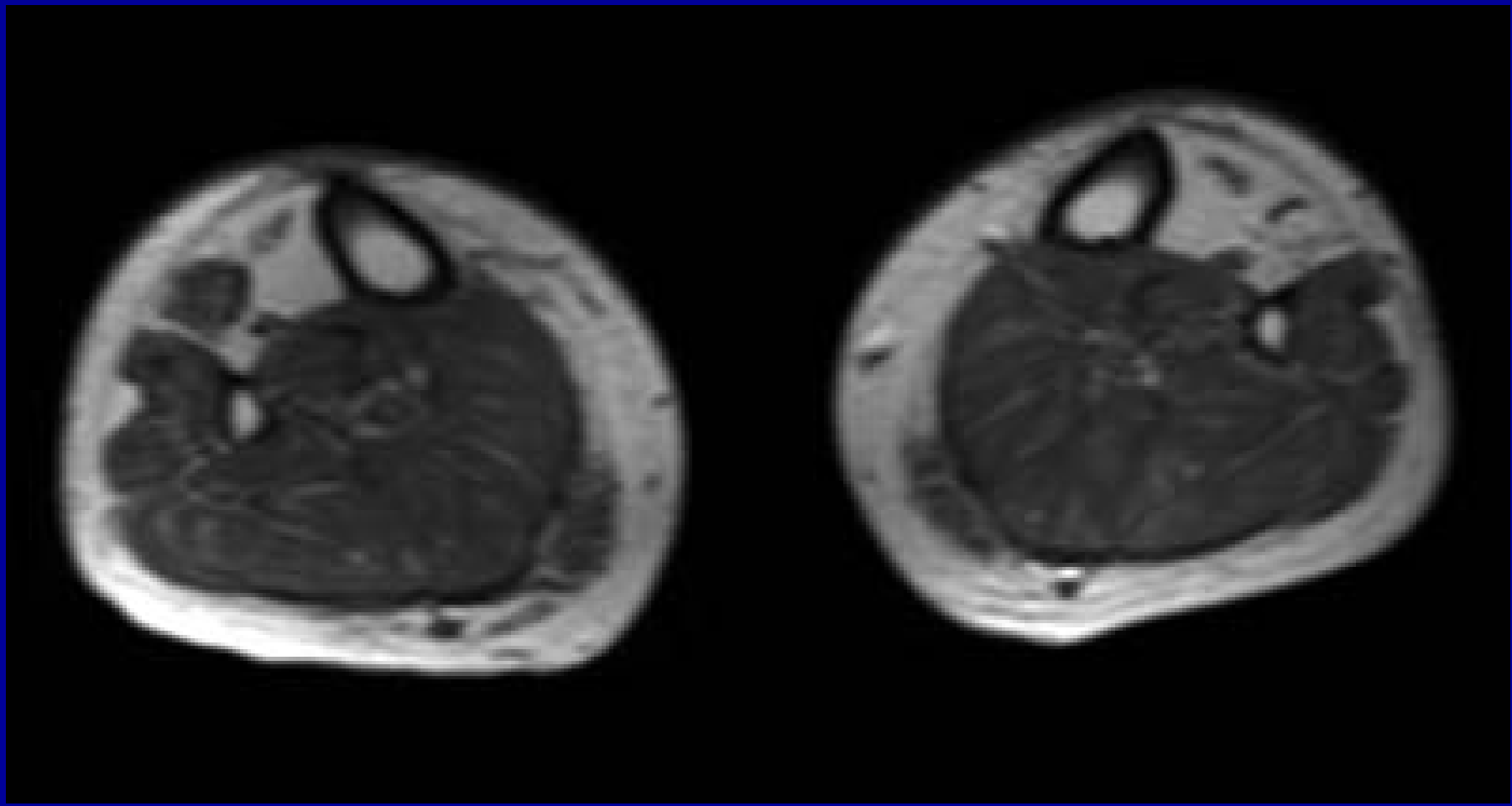
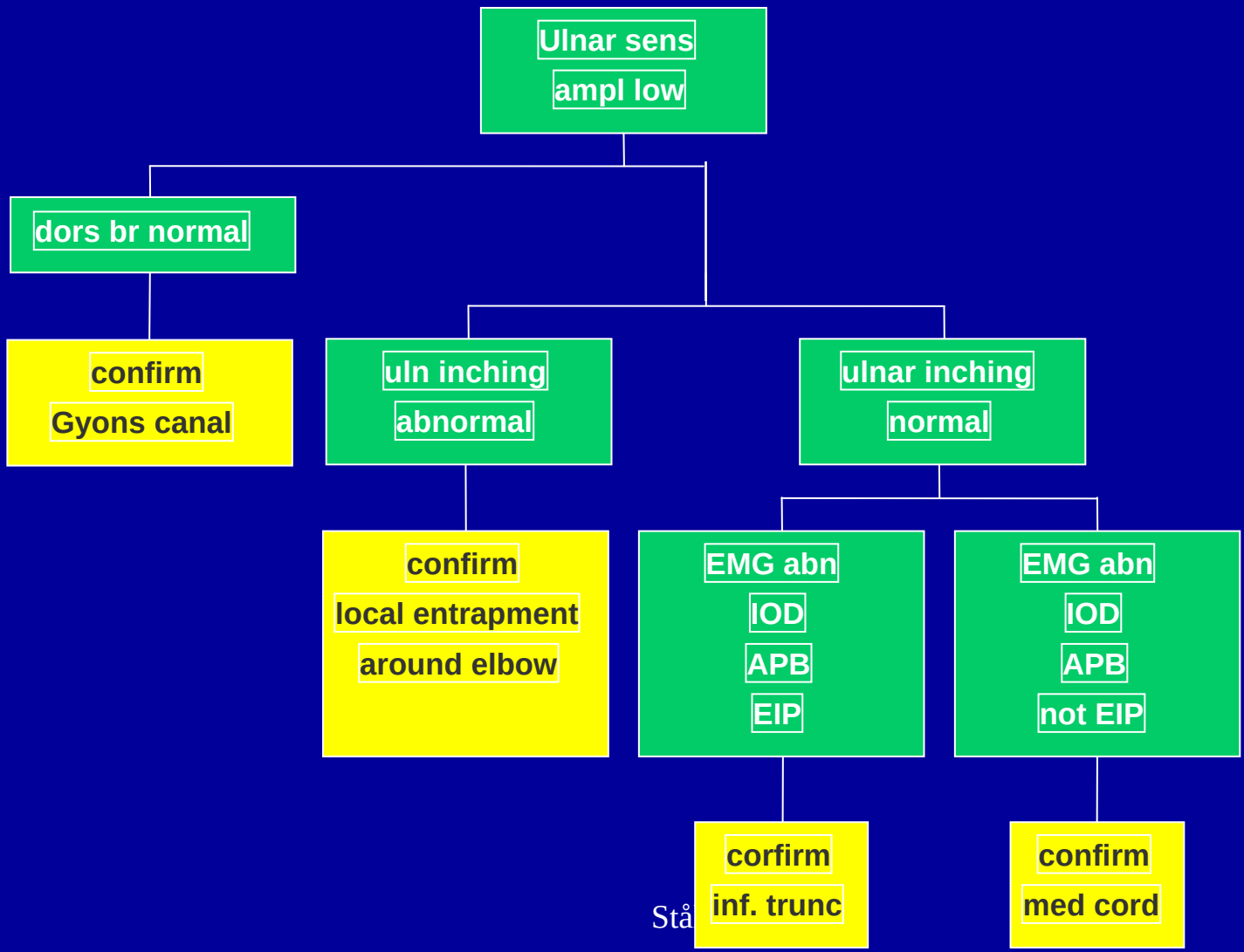
MRI in muscle disorders



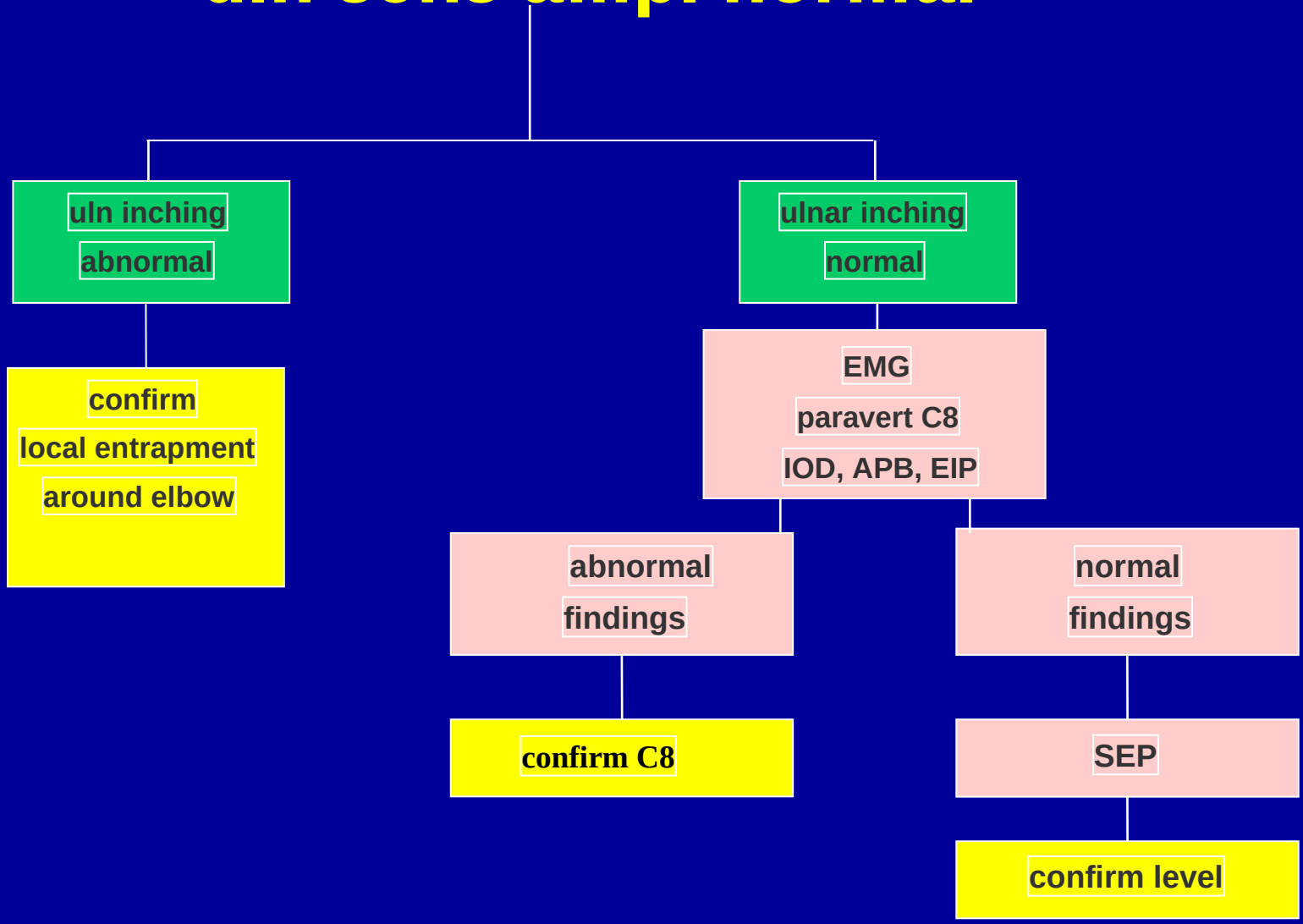
Titinopathy (Udd)

Courtesy Torbergsen,Löseth

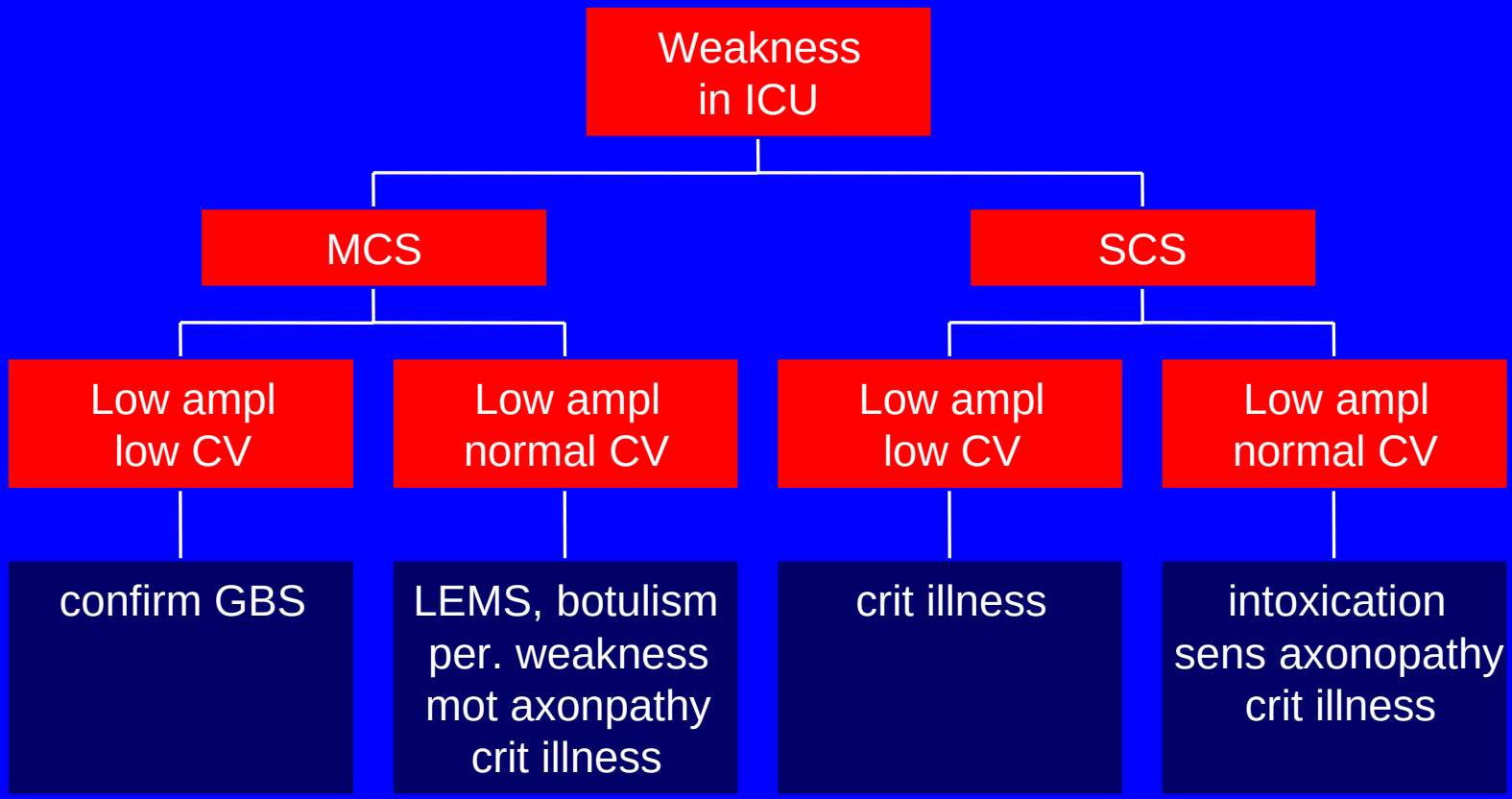
Numbness dig IV-V
“uln sens ampl low”



Numbness dig IV-V
“uln sens ampl normal”



Weakness in ICU, start with neurography



If neurography normal - go to EMG

Weakness in ICU
EMG