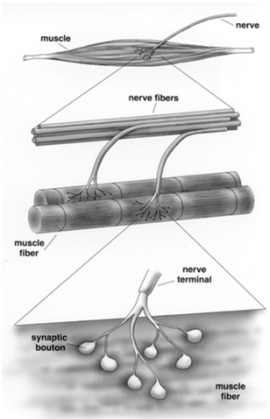
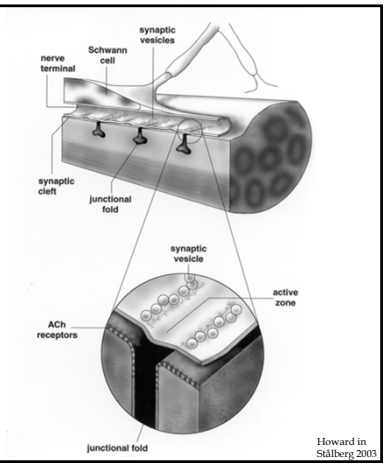
Testing
Neuromuscular transmission

Erik Stålberg

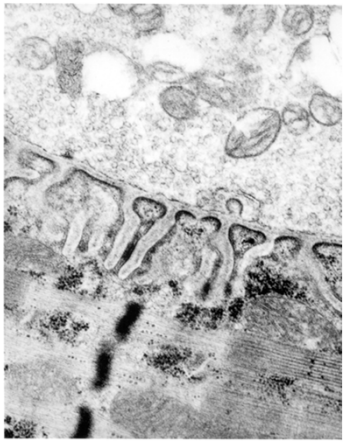


Howard in Stålberg, 2003

The neuromuscular junction

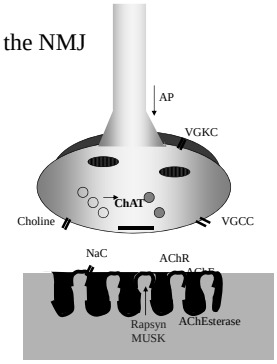


Howard in Stålberg, 2003



Howard in Stålberg, 2003

Multiple targets at the NMJ



Tests for MG

- **CLINICAL**
  - **History**
  - **Tests** → **fatigue, Tensilon, curare**
- **EMG**
  - **Rep nerve stimulation** → **slow-fast, postactivation, ischemia, curare, stair-case, paired stimuli**
  - **Needle-EMG** → **shape variability**
  - **SFEMG** → **jitter**
- **INTRACELL REC**
- **STAPEDIUS REFLEX**
- **OCULOGRAPHY**
- **TONOMETRY**
- **ACHR ANTIBODIES**

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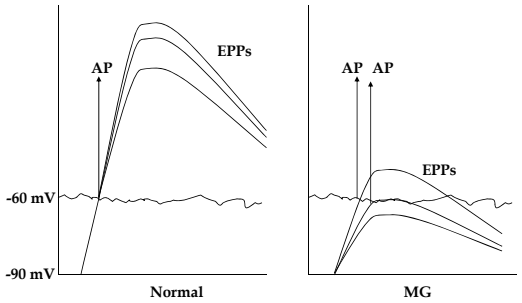
Intracellular recordings, - action potentials not shown



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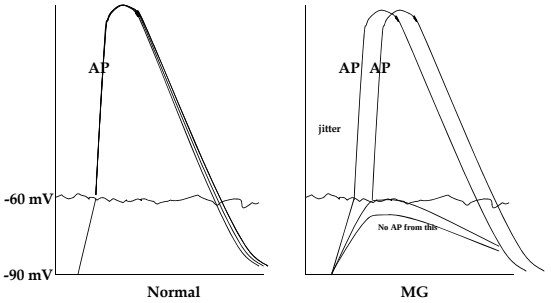
Intracellular recordings, schematic with APs



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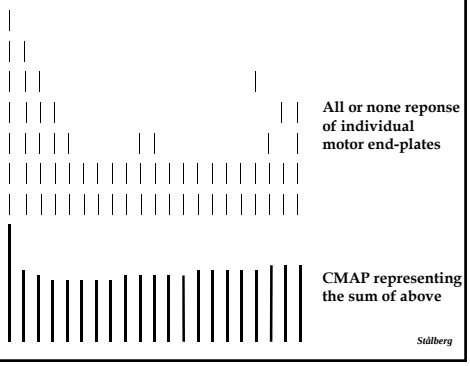
Schematic explanation to the myasthenic decrement



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Myasthenic disorders

- **Non-familial**
  - **Autoimmun MG (post)**
  - **LEMS (pre)**
  - **Toxins, drugs (pre or post)**
- **Congenital syndromes**
  - **presynaptic, synaptic, postsynaptic**

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Myasthenic disorders

- Myasthenia gravis
  - **reduced AChR**
  - **antibodies to AChR (85%)**
- Seroneg MG
  - **normal ACHR density**
  - **anti-MUSK antibodies in 2/3**
- LEMS
  - **reduced release of Ach**
  - **antibodies to presynaptic Ca-channels**
  - **autonomic symptoms**
  - **malignancy in 65%**

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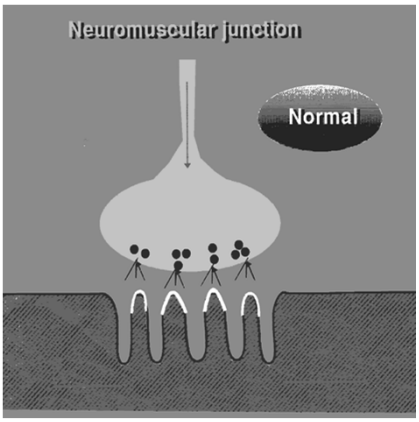
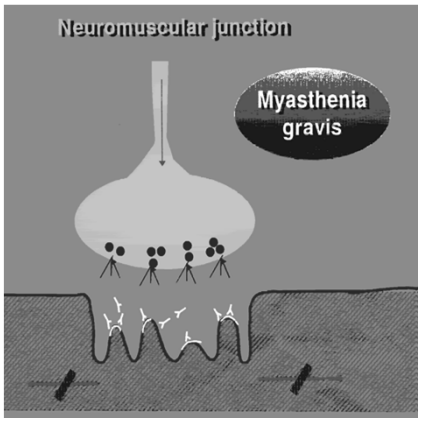


Stålberg



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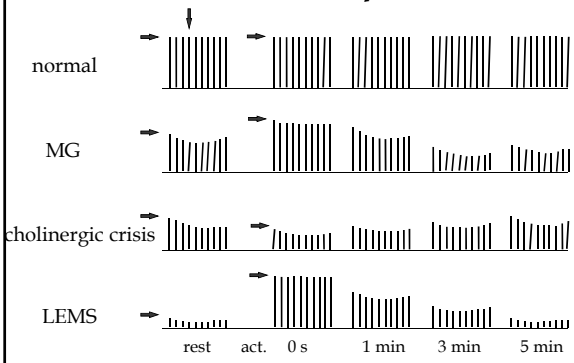
Decrement protocol



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Protocol

- 3 Hz, 10 stimuli
- immobilize the muscle
- max stim strength, 125%
- test at: rest after 20 sec of act, after 1,3,5,10 minutes

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Parameters to analyse

- initial amplitude
- decrement
- amplitude after activity (postactivation facilitation)
- decrement after activity
- ampl and decrement after 1, 3 and 5 min (postactivation exhaustion)

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Rep.nerve stimulation: considerations

- distal/proximal muscle
- rest/fatigue
- on/off treatment
- cold/warm
- stim. frequency
- muscle fixation

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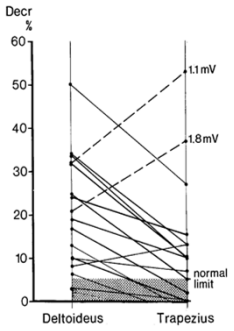
Muscles to test

Generalized MG
- Deltoideus
- Trapezius
- Anconeus
- Nasalis

Bulbar MG
- Nasalis
- Anconeus
- Trapezius

Ocular MG
- RNS is quite insensitive
- Nasalis
- Start with SFEMG jitter

Decrement in 2 proximal muscles



Mean decrement	**24.8**	**15.8**
Mean amplitude	**8.0**	**6.4**

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Is there?

- myasthenia
- good/ bad effect of AchE inhib´s
- cholinergic overdose
- LEMS
- McArdle, myotonia

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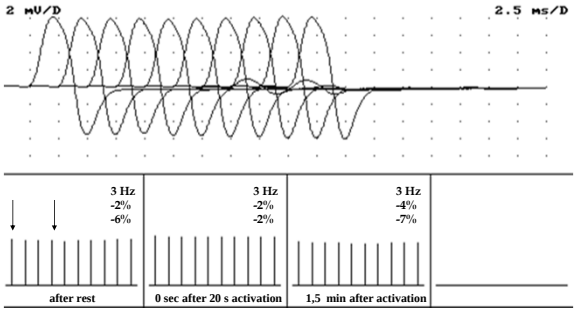
Repetitive nerve stimulation Anconeus muscle



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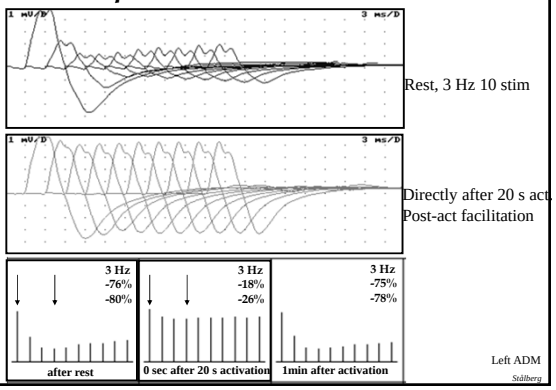
Repetitive nerve stimulation in a patient with severe MG



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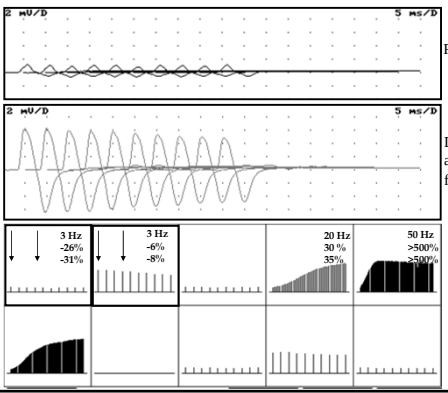
***LEMS,** Repetitive nerve stimulation at rest*



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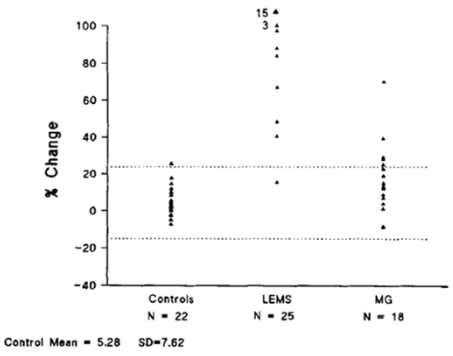
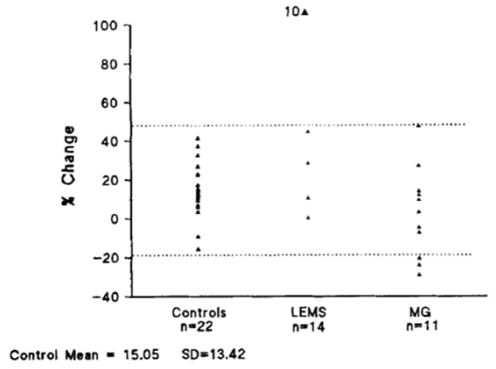
Facilitation after exercise in LEMS

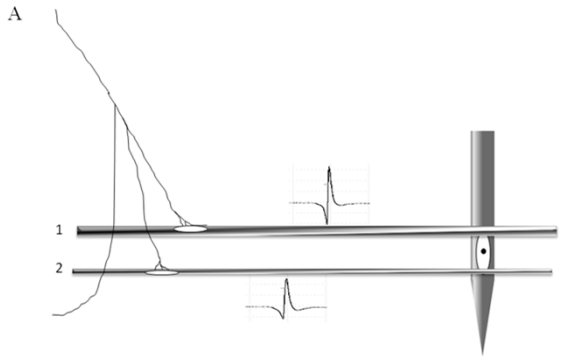


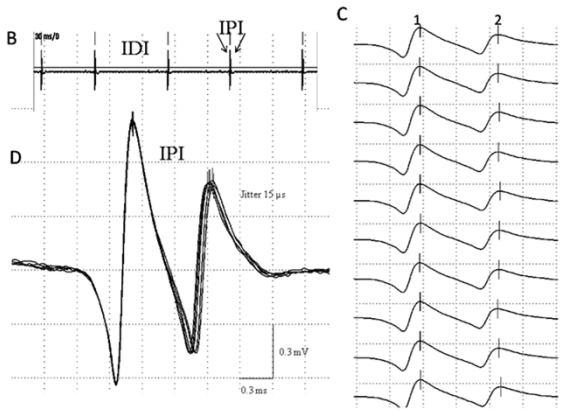
Tim and Sanders, M&N, 1994

Facilitation with 20 Hz stimulation in LEMS

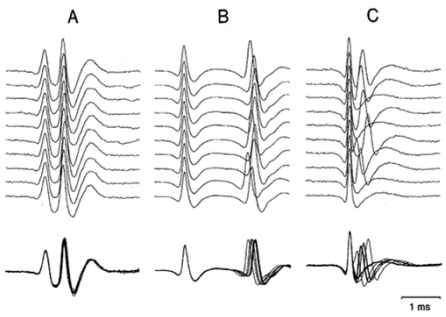


Tim and Sanders, M&N, 1994





Single fiber action potentials



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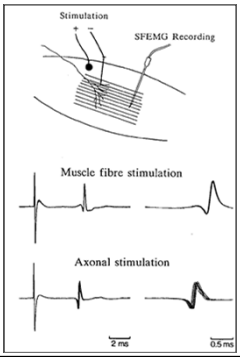
Intramuscular stimulation and SFEMG recording



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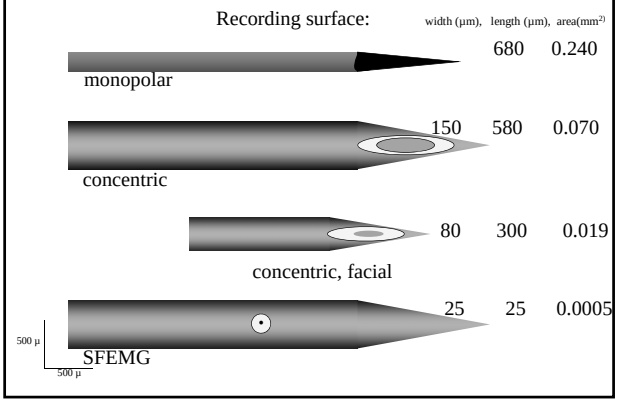
Measuring jitter with

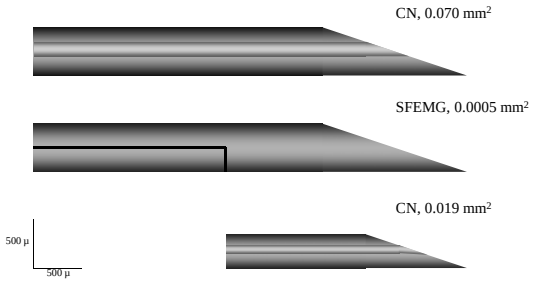
Concentric Needle electrodes

Erik Stålberg
Uppsala, Sweden

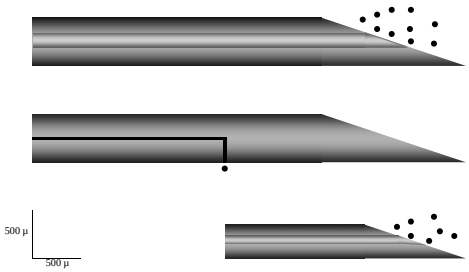
Four types of EMG electrodes



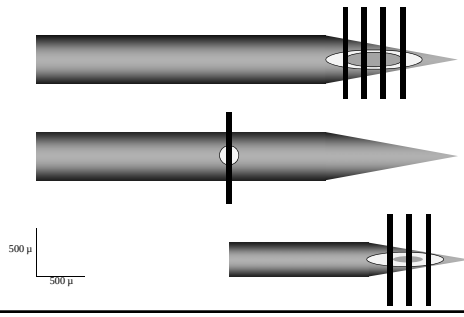
Three types of EMG electrodes



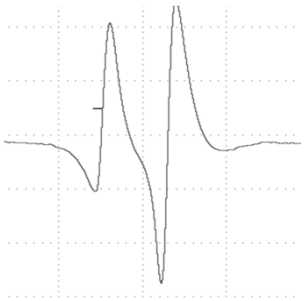
Three types of EMG electrodes



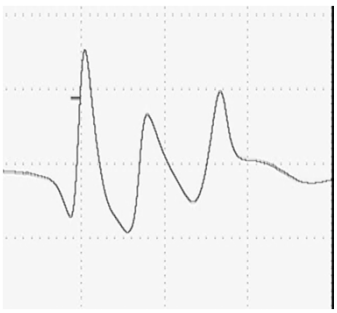
Three types of EMG electrodes



SFEMG

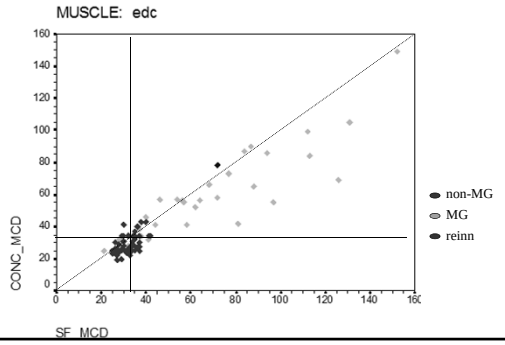


Jitter with conc needle electrode

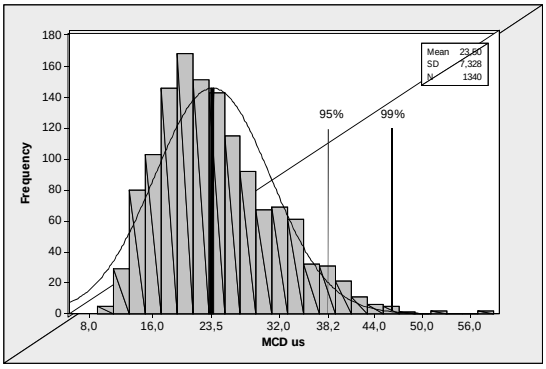


Jitter SF vs Conc, mixed diagn

#>10 values, total mtrl; n=92

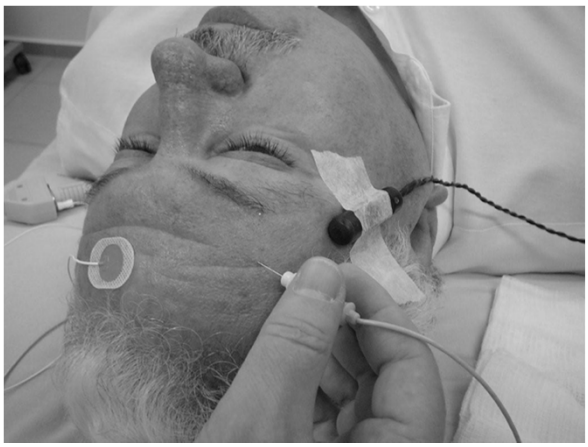


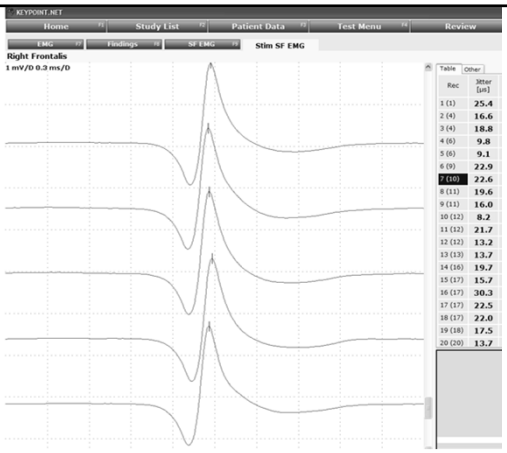
CNE in EDC, vol: mean MCD in 1340 individual pairs (67 subjects)

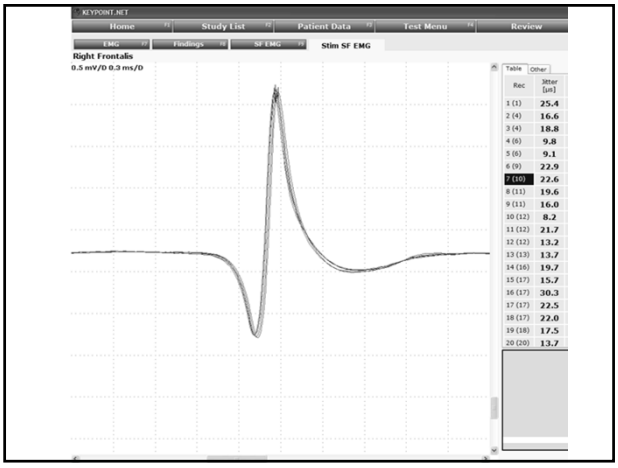


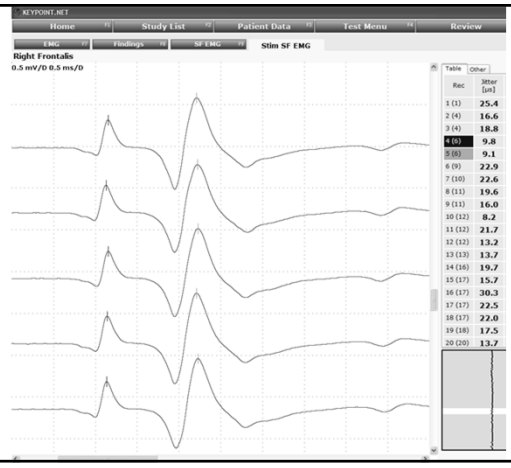
EDC: Extensor Digitorum Communis; MCD: mean consecutive difference; ULN: upper limit of normality

Kouyoumdjian, Stålberg 2006









Reference data

Kouyoumdjian & Stålberg (2007 - 2012)

Muscle	n	MCD mean	95%	99%	SFEMG #	Pool mean	95%	99%	SFEMG #
Voluntary Activation									
EDC	67	23.6	29.7	32.8	(35.4)	23.5	38.2	45.5	(51.3)
OO	50	24.7	31.0	34.1	(40.4)	24.7	39.0	46.1	(54.8)
FR	20	19.9	25.6	28.4	(35.5)	19.9	33.2	39.8	(53.5)
Electrical Stimulation *(* intramuscular microaxonal ** bar electrode)*									
EDC *	41	18.2	22.6	24.8	(25.0)	18.3	28.7	33.9	(40.0)
OO **	50	21.4	25.4	27.3	(21.0)	21.5	33.1	38.8	(30.0)
Frontalis **	20	16.0	21.5	24.2	(23.0)	16.0	28.0	33.9	(33.0)

 # 40 years (vol) or any age (stim)

Diagnostic tests for MG

% positive results from a total of 291 patients

Group	SFEMG	Decrement ADM	Decrement Delt	Stapedius reflex	Anti-AChr
Ocular					
EDC + Frontalis	**85**	**4**	**19**	**90**	**76**
EDC	**59**				
Mild generalized	**96**	**31**	**68**	**91**	**76**
Mod-severe generalized	**100**	**68**	**89**	**63**	**88**
Remission	**62**	**0**	**0**	**83**	

Stålberg Sanders 1981

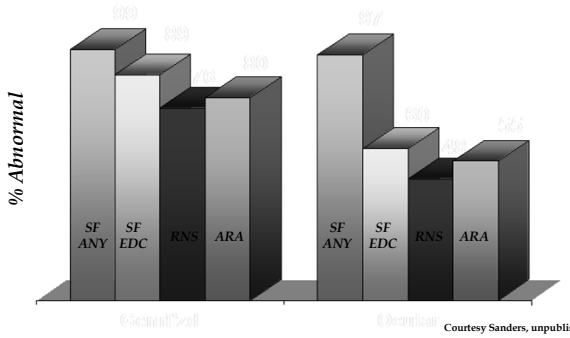
Sensitivity of Diagnostic Tests in MG

- 550 patients with acquired MG
- All tests performed before immunotherapy or thymectomy
- Ocular myasthenia (OMG)
  - weakness only in ocular muscles
- Generalized MG (GMG)
  - weak in any non-ocular muscle

Courtesy Sanders, unpublished

Sensitivity of initial tests

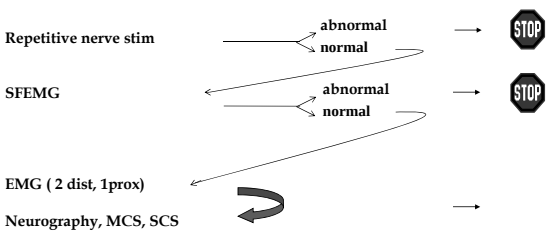
550 untreated MG patients



Courtesy Sanders, unpublished

MG

Protocol



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Some links

Sfemg.info (SFEMG meetings videos)

Keypointclub.com (simulators)