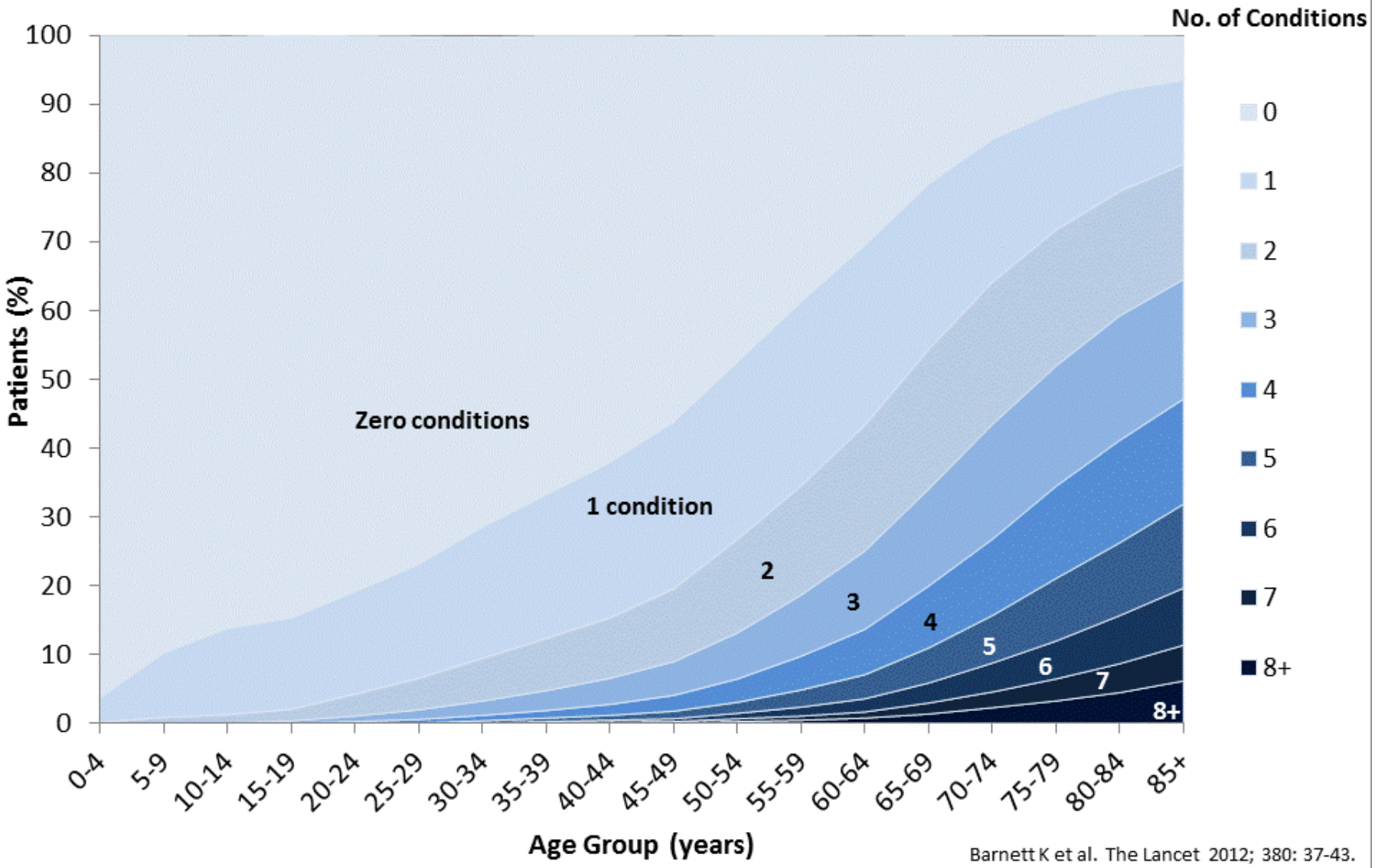
ME/CFS och överlappande syndrom

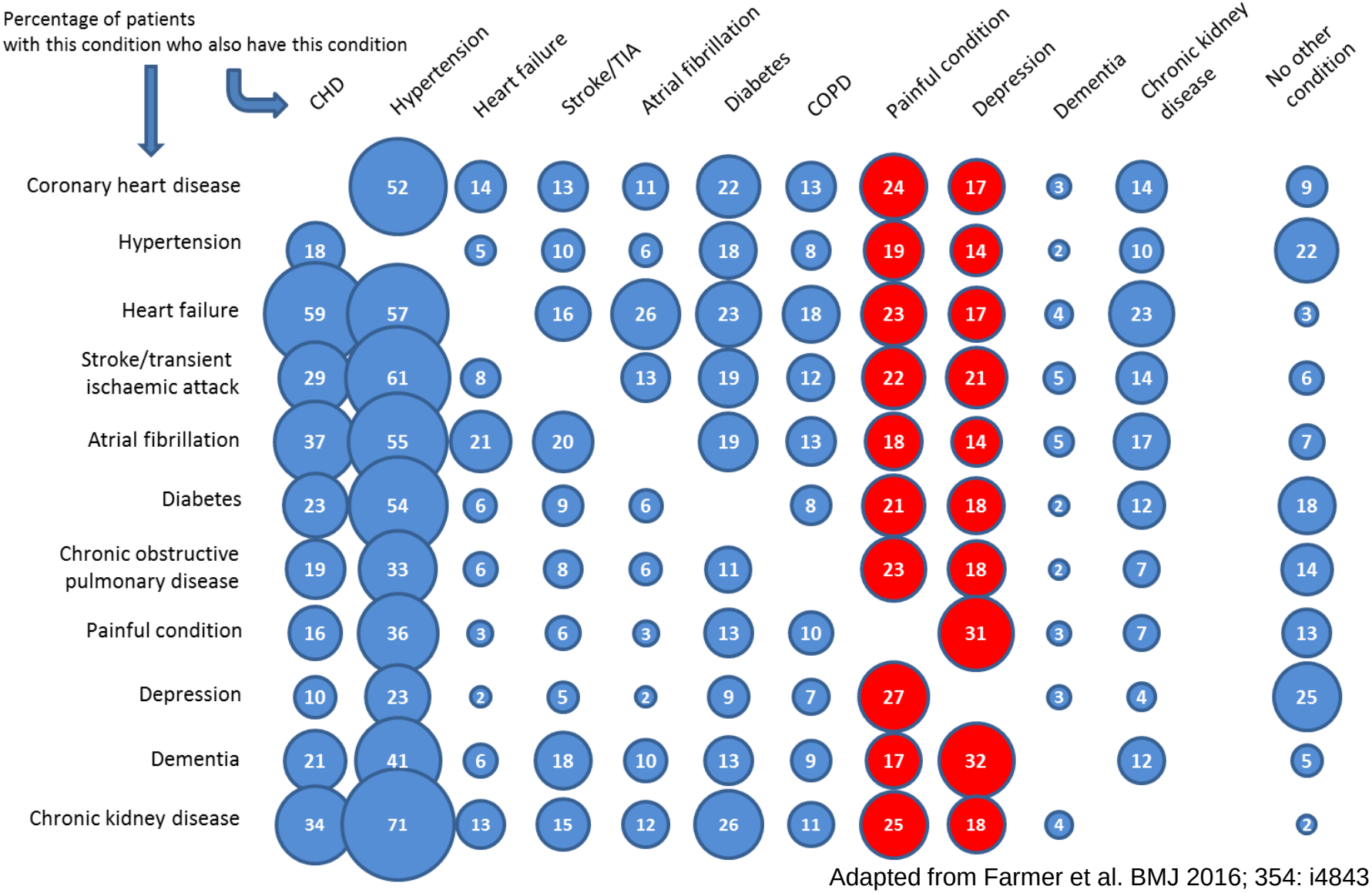
Bo C Bertilson, MD, PhD
Forskningsledare ME/CFS-Center
Akademiskt primärvårdscenter, Region Stockholm och
Sektionen för allmänmedicin och primärvård, NVS, Karolinska Institutet
Kliniker på Torvallakliniken

Overlapping syndromes – multimorbidity and age



Barnett K et al. The Lancet 2012; 380: 37-43.

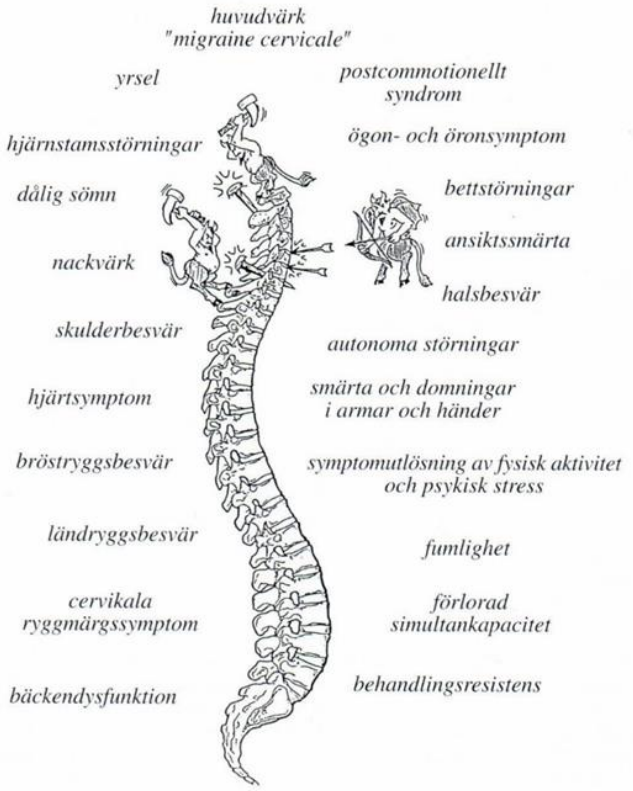
Overlapping syndromes - multimorbidity



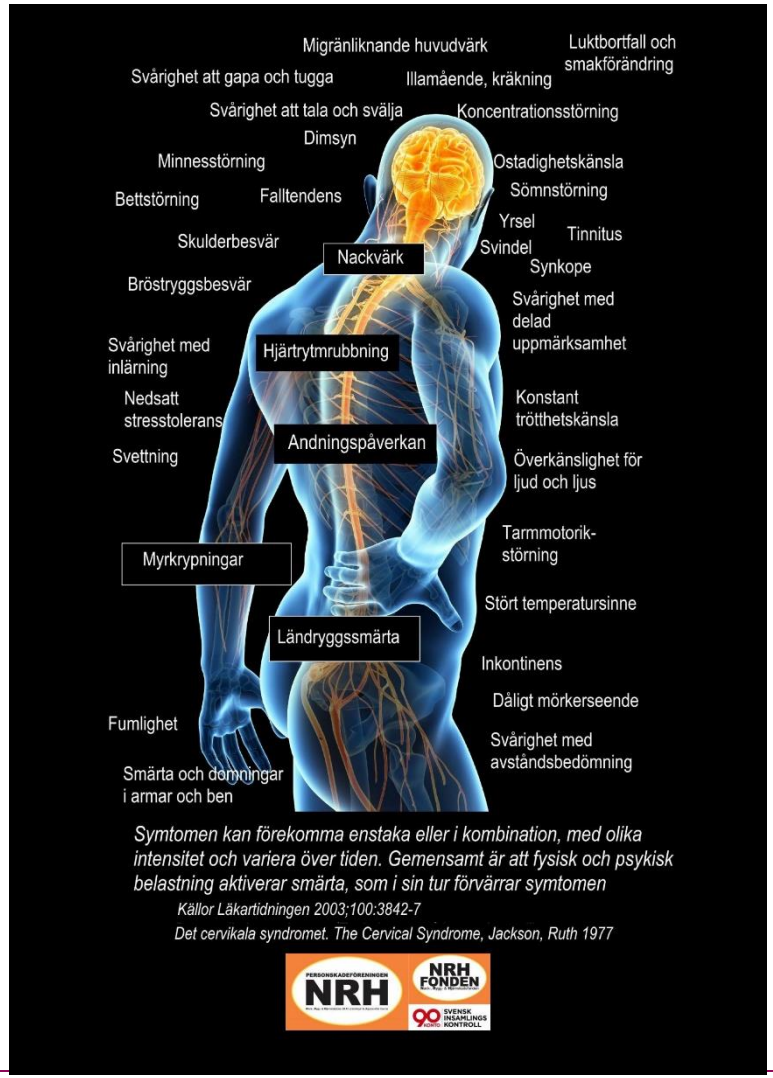
Adapted from Farmer et al. BMJ 2016; 354: i4843

Gunilla Bring avhandling år 1996

Citerar *”The Cervical Syndrome”*
av Jackson, Ruth från 1977



Figur 6
Det cervikala syndromet. (Teckningen är från omslaget till "The Cervical Syndrome", Jackson 1977).

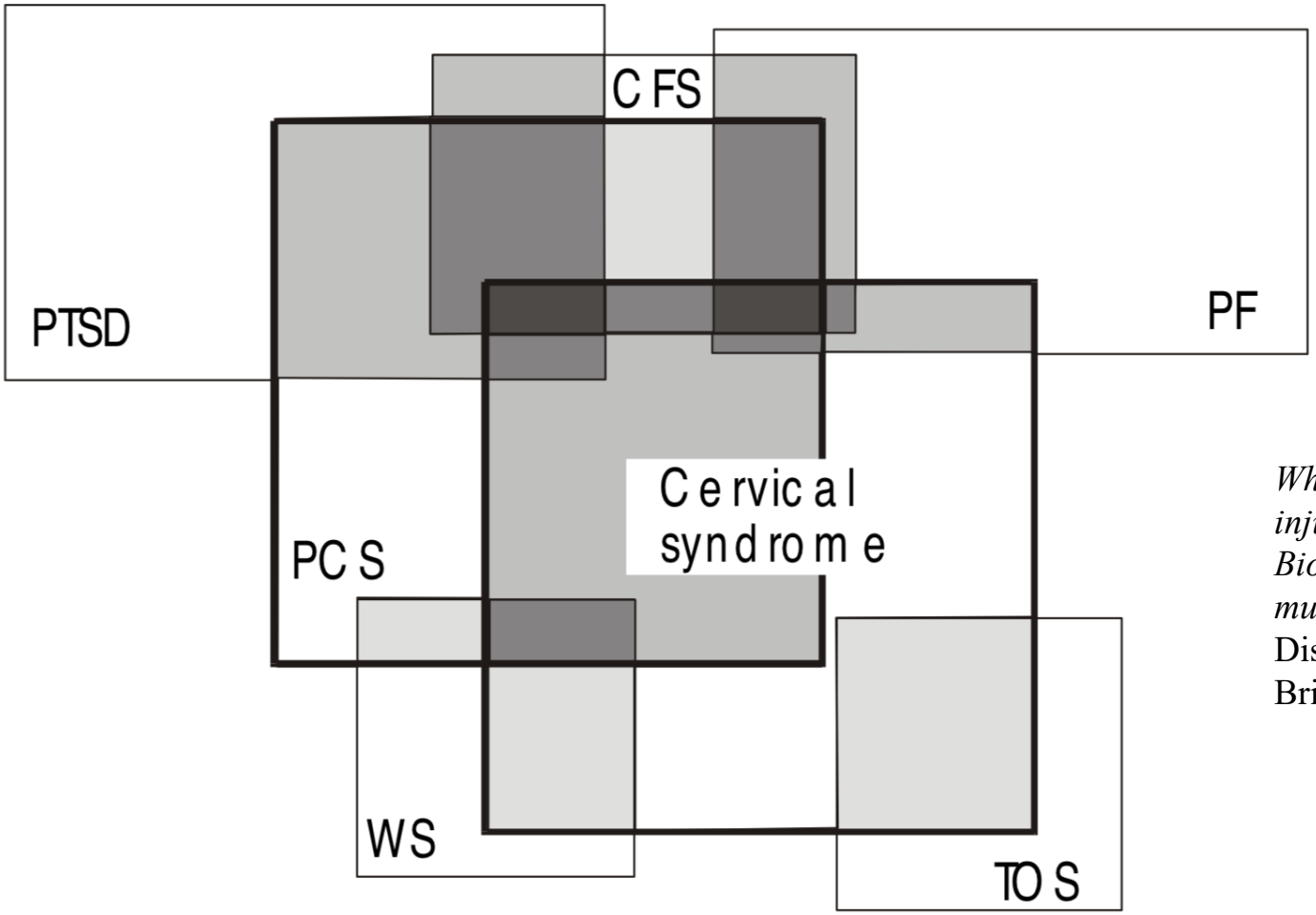


Symtomen kan förekomma enstaka eller i kombination, med olika intensitet och variera över tiden. Gemensamt är att fysisk och psykisk belastning aktiverar smärta, som i sin tur förvärrar symtomen

Källor Läkartidningen 2003;100:3842-7

Det cervikala syndromet. The Cervical Syndrome, Jackson, Ruth 1977

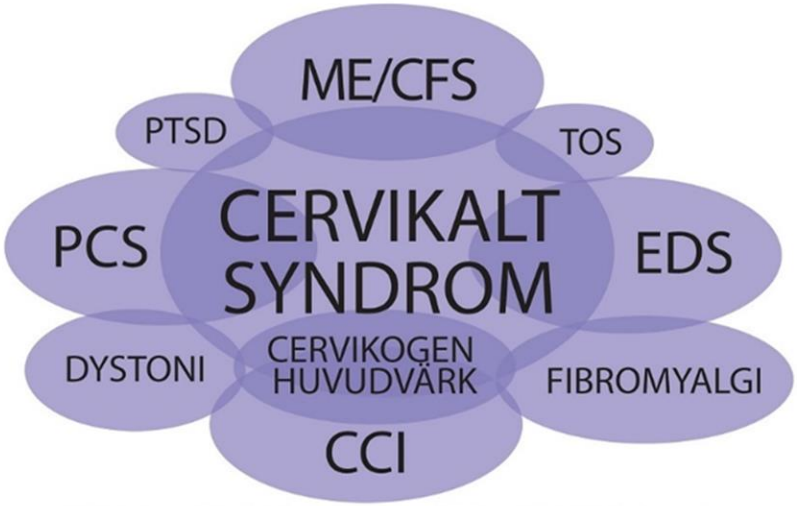
Överlappande syndrom?



Cervical syndrome, all the following symptoms may be included (Barré 1926, Decher 1969, Jackson 1977):

Whiplash associated injuries and disorders – Biomedical aspects of a multifaceted problem
Dissertation by Gunilla Bring, 1996

Overlapping syndroms ?

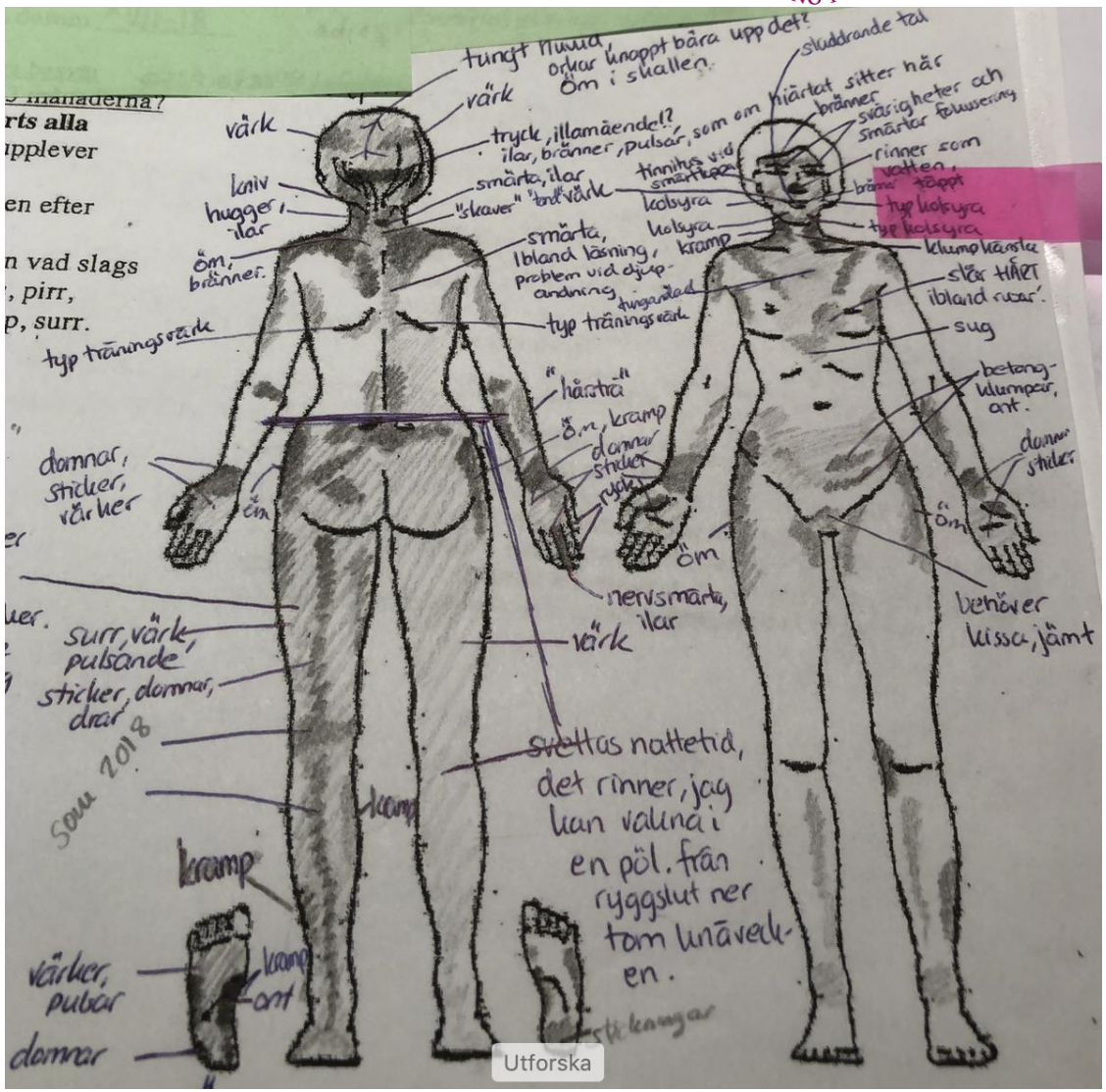


ME/CFS	Myalgisk Encefalomyelit/Kroniskt Trötthetssyndrom
PCS	Postcommotionellt Syndrom
EDS	Ehler Danlos Syndrom/Hypermobilitet
CCI	Kraniocervikal Instabilitet
PTSD	Posttraumatiskt Stressyndrom
TOS	Thoracic Outlet Syndrome

ME / CFS
Fibromyalgia
Myofascial Pain
Somatoform pain S
Stroke
EDS
Whiplash associated disorder
Myelopathy
Migrain / headache
POTS
Irritabel bowel syndrome
Arnold Chiare / Tonsillectopi
Etcetera
Idiopatic ic hypertension

Överlappande syndrom
En typisk patient

Konståkare
Fallolycka
Trafikolycka
Multiutredd
Fysioterapi
Smärtrehab
Neurokir
- ”Klart muskel-relaterade besvär”



Forskning

MYOPAIN 2001
Fifth World Congress on Myofascial Pain and Fibromyalgia
Portland, Oregon

“en tid då terrorns grymma ansikte och andra människors storhet visades upp”

Bo C Bertilson

Myopain 2001, Portland, BC congress report

Daniel Clauw, Ass. Professor, Georgtown Chronic Pain and Fatigue Research Center, Georgetown University, Washington DC ”***Fibromyalgia Associated Syndromes”*** There are great similarity between fibromyalgia and chronic fatigue syndrome, somatoform disease and other ”unexplained diseases" with widespread symptoms. Muscle aches and soreness, trigger points, headache, abnormal fatigue, sleep and concentration difficulties as well as visceral disorders and general supersensibility are commonplace and can be detected in over 20% of the public in the United States! Many soldiers ....

Myopain 2001, Portland, BC congress report

”I will prove that Fibromyalgia is a reflex sympathetic dystrophy”
Manuel Martinez-Lavin, Instituto Nacional de Cardiologia Mexico, Mexico City ***”The Autonomic Nervous System in Fibromyalgia”***. He referred to studies of Pomeranz which showed that patients with FM has a 24-hour sympaticotone increase in the autonomic nervous system. An example of this is that when a patient with FM raises up from lying position, the blood pressure reaction differs from normal.

K-G Henriksson, Linköping, presented the thesis ***"Is Fibromyalgia a Central Pain State"*** a pain state gradually developed and kept alive through a central sensitization.

Myopain 2001, Portland, BC congress report

Conclusion: ***no biomarker or effective treatment in sight.***

BC wrote: ”My own experience with fibromyalgia and patients with similar symptoms is that if you examine carefully enough, it is almost always possible to track a peripheral neurogenic dysfunction to one or more spinal levels from which sensitization and pain scattering occurs. Over time (years after trauma), radiological findings can often be found at expected segments of the spine, and if you ask - the patient may remember physical injury to the spine. Sometimes there has been an acute nerve involvement that may have been missed and sometimes the patient has forgotten the trauma… until they begin to develop stenosis, sometimes causing a "functional myelopathy".

Met Dan Heffez – neurosurgeon from Chicago

Myopain 2001, Portland, BC congress report

Conclusion: ***no biomarker or effective treatment in sight.***

BC wrote: "My own experience with fibromyalgia and patients with similar symptoms is that if you examine carefully enough, it is almost always possible to track a peripheral neurogenic dysfunction to one or more spinal levels from which sensitization and pain scattering occurs. Over time (years after trauma), radiological findings can often be found at expected segments of the spine, and if you ask - the patient may remember physical injury to the spine. Sometimes there has been an acute nerve involvement that may have been missed and sometimes the patient has forgotten the trauma… until they begin to develop stenosis, sometimes causing a "functional myelopathy".

Met Dan Heffez – neurosurgeon from Chicago

Is There an Association between Cervical Myelopathy (CM) and Fibromyalgia (FM)?

Heffez et al, 2001

We investigated a proposed association between FM and CM.

Prospective, nonrandomized, case control outcome evaluation of surgical (n = 55) vs. conservative (n = 43) treatment of CM in patients with FM. Patient follow-up included a symptom checklist completed every 3 months and the SF-36 quality of life questionnaire completed at the initial and 6-month evaluations (78% response rate).

Is There an Association between Cervical Myelopathy (CM) and Fibromyalgia (FM)?

Heffez et al, 2001

At 6-month follow-up after surgery, there was a statistically significant improvement in the surgical group as compared with the nonsurgical group with regards to patient reported dizziness, numbness, pain, impaired balance, impaired memory, impaired concentration, disorientation, grip weakness, and irritable bowel syndrome (P = 0.04-0.002).

”….a potential association between cervical myelopathy and fibromyalgia in some patients is suggested.”

Treatment of cervical myelopathy in patients with the fibromyalgia syndrome: outcomes and implications

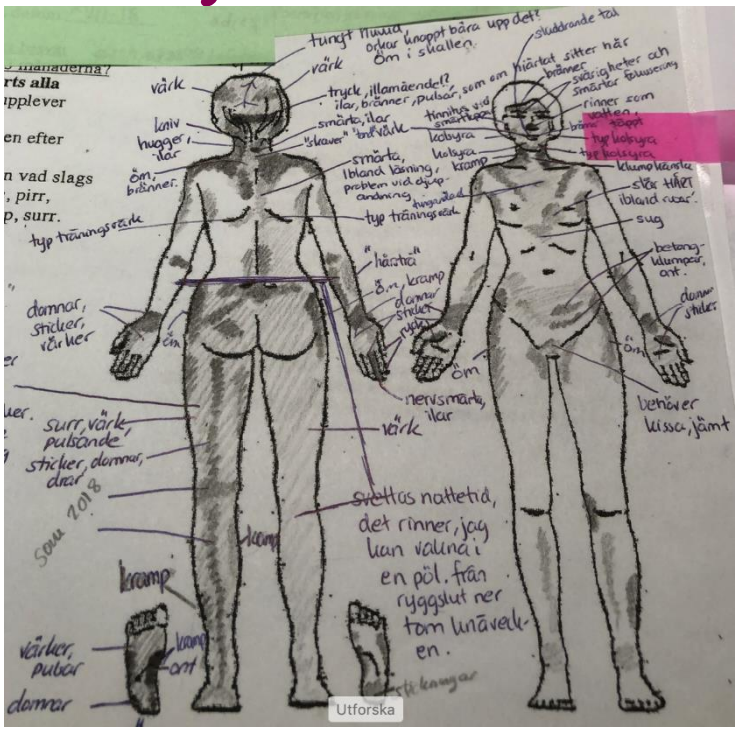
Heffez et al, Eur.Spine 2007

	Surgical group (n = 40)	Non-surgical group (n = 31)	P value
Age (years)	44.6 (SD 11.8)	41.4 (SD 11.2)	0.25
Sex (% female)	34 (85%)	28 (90%)	0.72
Duration of illness (years)	5.9 (SD 4.5)	7.4 (SD 5.5)	0.24
Craniospinal trauma	26 (65%)	20(64%)	0.85
Number of symptoms	24.6 (SD 4.8)	24.6 (SD 4.5)	0.97
Painful body regions	7.5 (SD 4.2)	8.2 (SD 3.6)	0.59

Table 2 Symptom prevalence at baseline in the surgical and non-surgical groups

Symptom	Surgery, *n* (%)	Non-surgery, *n* (%)	*P* value
Fatigue	39 (98%)	31 (100%)	>0.999
Fatigue after exertion	40 (100%)	31 (100%)	–
Decreased memory	38 (95%)	27 (87%)	0.393
Difficulty concentrating	39 (98%)	31 (100%)	>0.999
Disorientation	21 (53%)	17 (55%)	0.845
Body pain	36 (90%)	31 (100%)	0.126
Headaches	36 (90%)	27 (87%)	0.722
Decrease in strength	34 (85%)	31 (100%)	0.032
Decrease grip strength	30 (75%)	26 (84%)	0.398
Gait instability	35 (88%)	28 (90%)	>0.999
Depression	20 (50%)	17 (55%)	0.812
Blurred/double vision	23 (58%)	21 (68%)	0.463
Irritable bowel syndrome	27 (68%)	26 (84%)	0.170
Limb numbness	15 (60%)	18 (58%)	0.808
Limb paresthesiae	31 (78%)	23 (74%)	0.785
Photophobia	34 (85%)	25 (81%)	0.753
Dizziness	26 (65%)	24 (77%)	0.302
Chronic Nausea	12 (30%)	14 (45%)	0.188
Clumsiness	30 (75%)	24 (77%)	0.813
Cold intolerance	28 (70%)	28 (90%)	0.037

Overlapping syndromes?



Treatment of cervical myelopathy in patients with the fibromyalgia syndrome: outcomes and implications, Heffez et al, Eur.Spine 2007

Table 3 Prevalence of neurological signs in the surgical and non-surgical groups

Neurological sign	Surgical, *n* (%)	Non-surgical, *n* (%)	*P* value
Occipital tenderness	10 (25.0%)	4 (12.9%)	0.186
Facial Hypesthesia	7 (17.5%)	2 (6.5%)	0.165
XII CN	1 (2.5%)	1 (3.2%)	>0.999
Absent gag reflex	15 (37.5%)	7 (22.6%)	0.178
VI CN	2 (5.0%)	0 (0%)	0.501
Nystagmus	4 (10.0%)	2 (6.5%)	0.690
Dysmetria	8 (20.0%)	4 (12.9%)	0.429
Disdiadokokinesia	5 (12.5%)	2 (6.5%)	0.457
Tandem walk	8 (20.0%)	2 (6.5%)	0.104
Romberg sign	15 (37.5%)	5 (16.1%)	**0.047**
Ataxia	3 (7.5%)	1 (3.2%)	0.627
Heel/shin	5 (12.5%)	3 (9.7%)	>0.999
Thoracic sensory level (cold, pin)	35 (89.7%)	29 (93.5%)	0.687
Impaired position sense (feet)	8 (20.0%)	3 (9.7%)	0.233
Ankle clonus	11 (27.5%)	8 (25.8%)	0.873
Positive Hoffman sign	10 (25.0%)	9 (29.0%)	0.703
Reflex recruitment	22 (55.0%)	13 (41.9%)	0.275
Worsening with neck extension[a]	36 (90.0%)	26 (83.9%)	0.441
Weakness	7 (17.5%)	8 (25.8%)	0.395
Hyper-reflexia	27 (67.5%)	20 (64.5%)	0.792
Hypo-reflexia	10 (25.0%)	8 (25.8%)	0.938

Karolinska Institutet

Overlapping syndromes and signs?

Treatment of cervical myelopathy in patients with the fibromyalgia syndrome: outcomes and implications,

Heffez et al, Eur.Spine 2007

Treatment of cervical myelopathy in patients with the fibromyalgia syndrome: outcomes…Heffez et al. 2007

Sign	Present at baseline	30 day improved/ resolved	30 day same	30 day worse
Occipital tenderness	10 (25.6%)	3 (30%)	5 (50%)	2 (20%)
Facial hypesthesia	7 (17.5%)	5 (83%)	1 (17%)	0 (0%)
XII	1 (2.5%)	1 (100%)	0 (0%)	0 (0%)
Absent gag reflex	15 (37.5%)	0 (0%)	13 (100%)	0 (0%)
VI	2 (5.0%)	1 (50 %)	1 (50%)	0 (0%)
Nystagmus	4 (10.0%)	2 (50 %)	2 (50%)	0 (0%)
Dysmetria	8 (20.0%)	5 (63%)	3 (37%)	0 (0%)
Disdiadokokinesia	5 (12.5%)	4 (100%)	0 (0%)	0 (0%)
Tandem Walk	8 (20.0%)	7 (88%)	1 (12%)	0 (0%)
Romberg	15 (37.5%)	12 (80%)	2 (14%)	1 (6%)
Ataxia	3 (7.5%)	2 (67%)	1 (33%)	0 (0%)
Heel/shin	5 (12.5%)	2 (40%)	3 (60%)	0 (0%)
Sensory level pin, temperature	35 (89.7%)	16 (53%)	13 (43%)	1 (4%)
Position sense	8 (20.0%)	5 (63%)	3 (37%)	0 (0%)
Clonus	11 (27.5%)	9 (82%)	2 (18%)	0 (0%)
Hoffman	10 (25.0%)	6 (60%)	3 (30%)	1 (10%)
Recruitment	22 (55.0%)	7 (32%)	14 (64%)	1 (4%)
Weakness	7 (17.5%)	7 (100%)	0 (0%)	0 (0%)
Hyper-reflexia	27 (67.5%)	9 (35%)	14 (54%)	3 (11%)
Hypo-reflexia	10 (25.0%)	1 (12.5%)	6 (75%)	1 (12.5%)

Treatment of cervical myelopathy in patients with the fibromyalgia syndrome: outcomes…Heffez et al. 2007

Table 9 Number of patients who reported symptom at baseline and who reported improvement or worsening at the 1 year follow-up

Symptom	S group			NS group			*P*
	N	Improved	Worse	*N*	Improved	Worse	
Fatigue	39	23 (59%)	4 (10%)	31	3 (10%)	5 (16%)	<0.001
Exercise on exertion	40	20 (50%)	3 (8%)	31	2 (6%)	6 (19%)	<0.001
Decreased memory	38	26 (68%)	2 (5%)	27	3 (11%)	7 (26%)	<0.001
Impaired concentration	39	31 (79%)	1 (3%)	31	4 (13%)	7 (23%)	<0.001
Disorientation	21	18 (86%)	0 (0%)	17	5 (29%)	2 (12%)	0.002
Body pain	36	22 (61%)	1 (3%)	31	5 (16%)	9 (29%)	<0.001
Headaches	36	26 (72%)	0 (0%)	27	4 (15%)	6 (22%)	<0.001
Decreased strength	34	23 (68%)	2 (6%)	31	3 (10%)	8 (26%)	<0.001
Decreased grip	30	21 (70%)	1 (3%)	26	2 (8%)	6 (23%)	<0.001
Impaired balance	35	25 (71%)	4 (11%)	28	4 (14%)	4 (14%)	<0.001
Depression	20	12 (60%)	0 (0%)	17	3 (18%)	3 (18%)	0.018
Blurred vision	23	18 (78%)	0 (0%)	21	4 (19%)	1 (5%)	<0.001
Irritable bowel syndrome	27	18 (67%)	3 (11%)	26	3 (12%)	7 (27%)	<0.001
Limb numbness	25	16 (64%)	0 (0%)	18	0 (0%)	5 (28%)	<0.001
Limb tingling	31	19 (61%)	0 (0%)	23	2 (9%)	5 (22%)	<0.001
Photophobia	34	20 (59%)	2 (6%)	25	2 (8%)	4 (16%)	<0.001
Dizziness	26	21 (81%)	0 (0%)	24	4 (17%)	2 (8%)	<0.001
Nausea	12	12 (100%)	0 (0%)	14	6 (43%)	1 (7%)	0.003
Clumsiness	30	20 (67%)	0 (0%)	24	2 (8%)	6 (25%)	<0.001
Intolerance to cold	28	17 (61%)	0 (0%)	28	4 (14%)	5 (18%)	<0.001
Painful body regions	40	4.95 ± 3.79		31	7.54 ± 3.81		<0.005

Treatment of cervical myelopathy in patients with the fibromyalgia syndrome: outcomes and **implications**

A detailed neurological examination should be incorporated into the evaluation of every patient considered to have fibromyalgia. The finding of cervical myelopathy warrants radiological investigation to exclude a treatable cause. More intriguing, in view of these results, is the possibility that, in some patients, cervical myelopathy may be the underlying cause of the fibromyalgia syndrome.

A large-scale study to determine the prevalence of cervical myelopathy in a randomly selected group of fibromyalgia patients is warranted.

Heffez et al, Eur.Spine 2007

Improvement of severe ME/CFS symptoms following surgical treatment of cervical spinal stenosis. Rowe et al 2018

Al 3 patients neurological findings including reflex dysfuntion

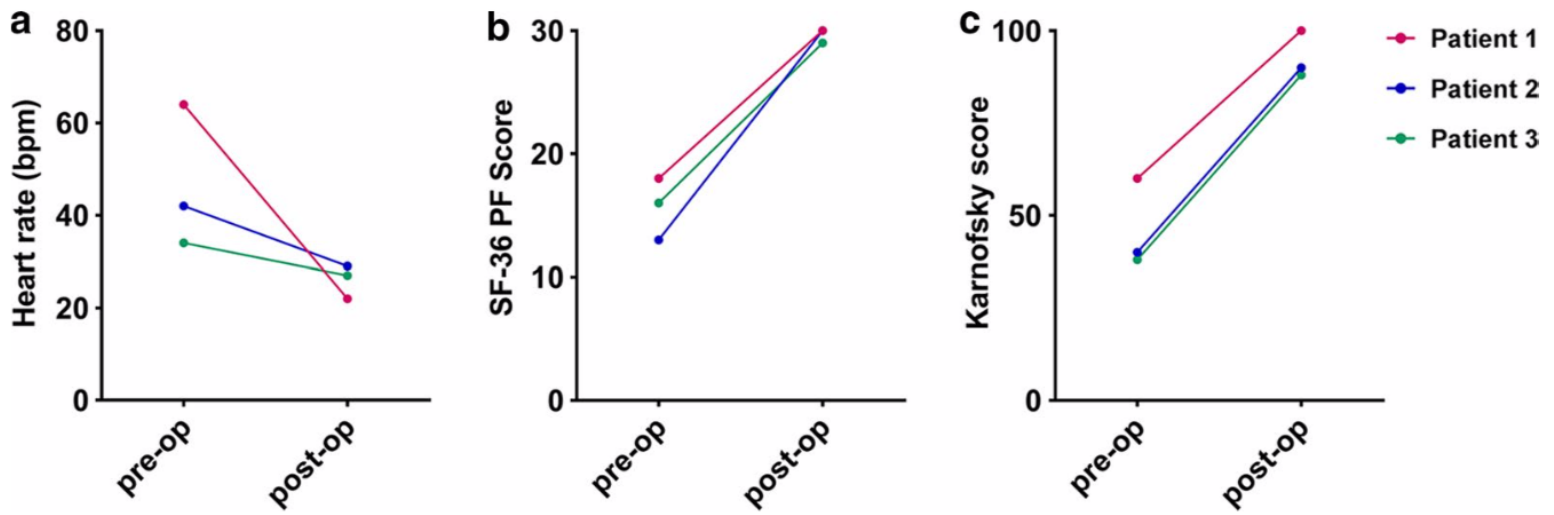


Fig. 4 **a** Improvement in the maximum increase in heart rate from supine to the peak value during 10-min of standing, pre- and post-operatively. The standing tests were performed at varying intervals after surgery (after 4 years for Patient 1, and after 1 year for Patients 2 and 3). All three patients had resolution of POTS. **b** Self-reported scores of the physical function subscale of the SF-36 measure, pre- and post-operatively at the same post-operative intervals as in a. **c** Improvements on the physician-assigned Karnofsky scores for each patient, pre- and 1-year post-operatively

Rowe *et al. J Transl Med (2018), John Hopkins Univ.*

Improvement of severe ME/CFS symptoms following surgical treatment of cervical spinal stenosis, Patient 1.

Girl 12 yr, stomach ache, increasing ME/chronic fatigue syndrom over time, could not attend school last 2.5 yr.

Disc replacement at age 21.
Symptom free 2 months post-op,
start to work, 5 yrs post op full-time university studies + work

Rowe *et al. J Transl Med (2018), John Hopkins Univ.*

Patient 2

Woman, healthy, active, until age 29 when developed profound fatigue, PEM, difficulties with short-term memory and concentration, headaches, myalgias, arthralgias, burning in legs, numbness in limbs, electric sensations in arms, difficulty swallowing and clumsy gait – needed wheelchair. Anxiety and depression.

Disc replacement at age 35. Week after out walking. At 20 months, she could exercise on an elliptical machine and recumbent bicycle, perform daily house-keeping chores, run multiple errands in a day, paint the interior rooms of her parents' house. She was able to successfully discontinue 3 of the 4 antidepressant/anti-anxiety medications.

Rowe *et al. J Transl Med (2018), John Hopkins Univ.*

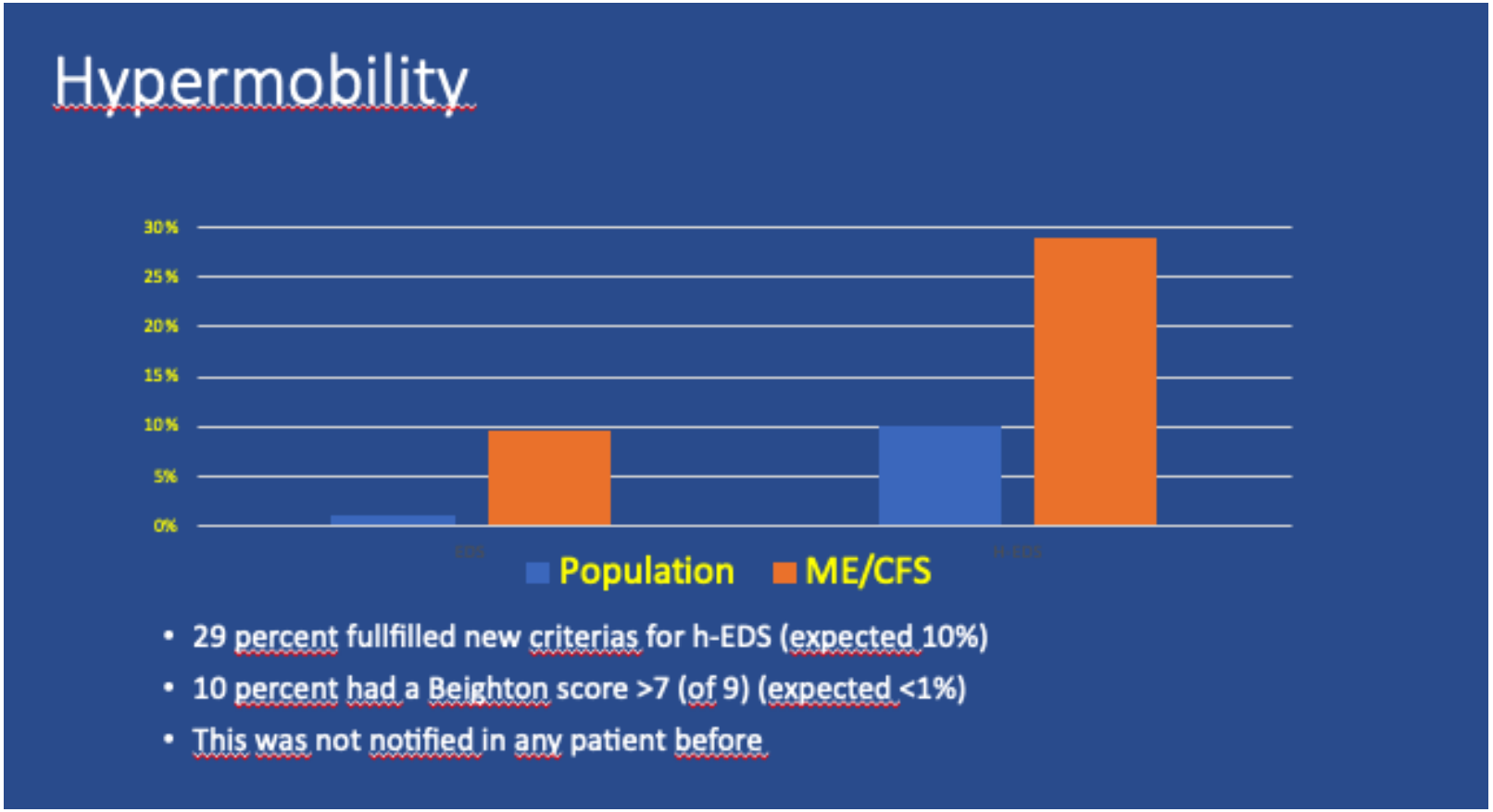
Patient 3

Woman, healthy, active, until age 31 when developed profound fatigue upon return from an overseas trip. Stopped working after 4 months. Unrefreshing sleep, post-exertional malaise, difficulty with concentration, headache, arthralgias, myalgias, nausea, lightheadedness, tremulousness, visual disturbances, decreased fine motor coordination. Anxiety and depression emerged as symptoms progressed.

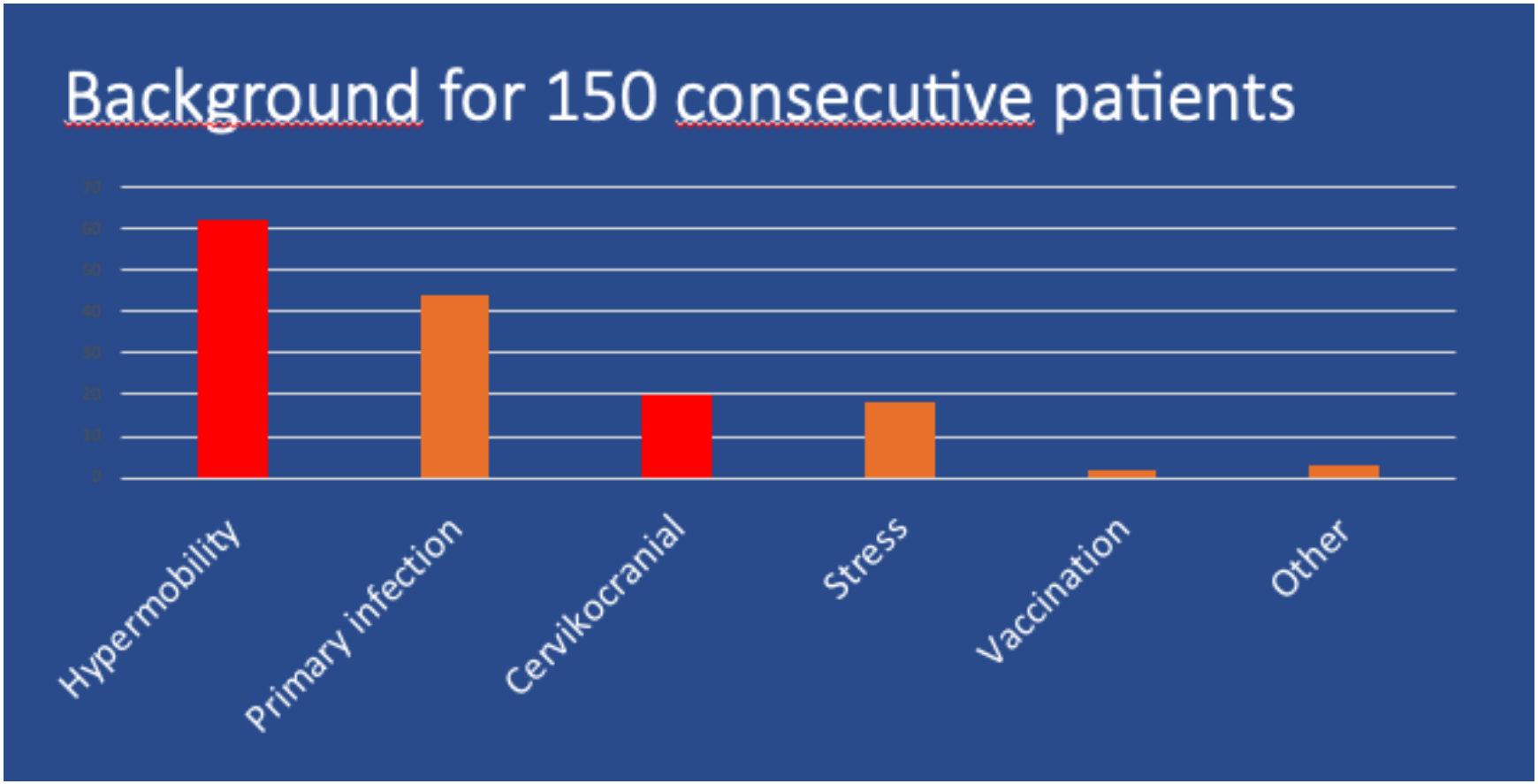
Disc replacement at age 35. Tremor, headache, right shoulder and neck discomfort all resolved first week after surgery + lower HR. 3 months postop able to complete downhill ski runs. 7 months postop vigorous physical exercise. Cognition improved and able to read complex literature.

Rowe *et al. J Transl Med (2018), John Hopkins Univ.*

MEC preliminära data



MEC preliminära data

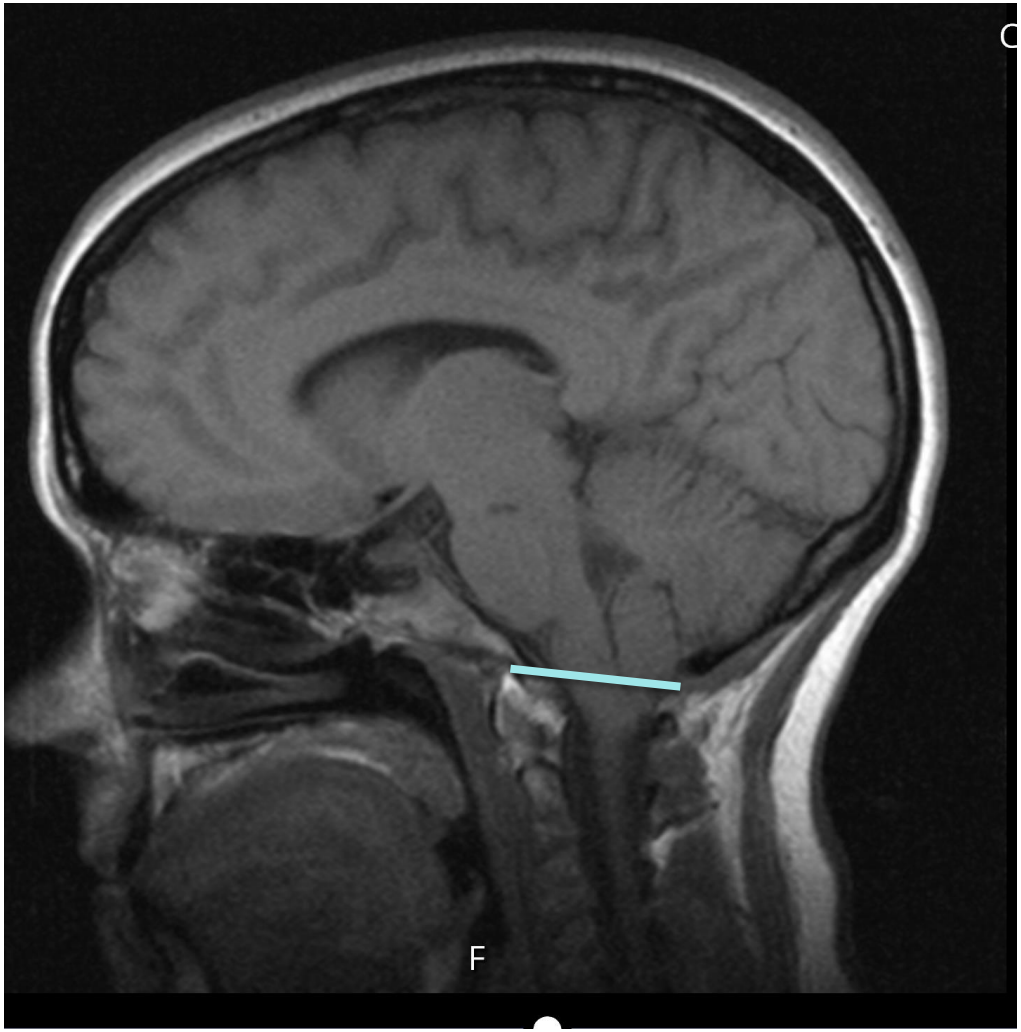


Överlappande syndrom MEC feb 2017

45 year old woman
Fibromyalgia for decades
Me/CFS diagnos 2013 at university clinic
Never heard of MRI findings
No neurological examination

Our findings:

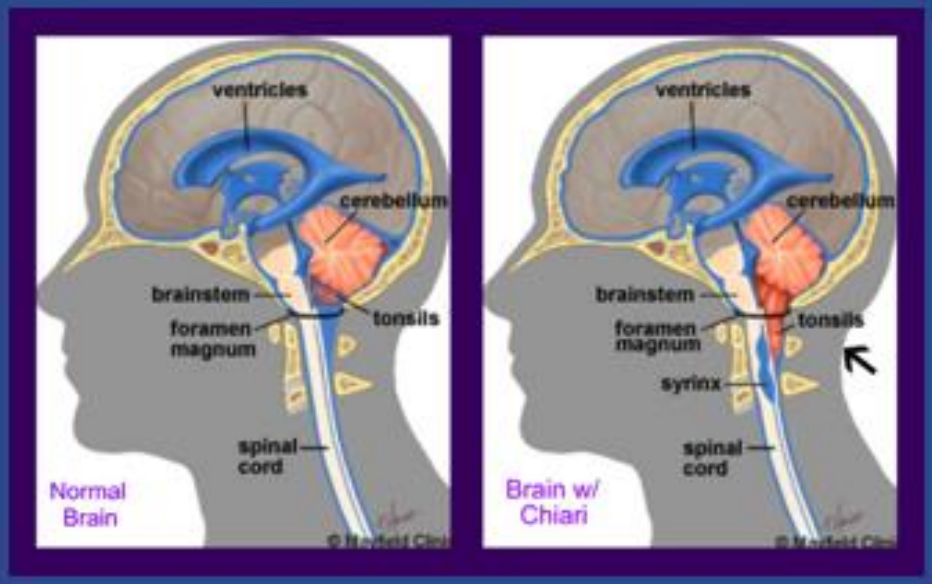
- craniocervical narrowing
- hypermobility
- sensibility pathological findings



ME – ”kulturell yttring”

~~”ME is a cultural manifestation”~~

Said by the specialist in neurology representing university in front of county administration and ME-physician evaluating the Proposed Manual for ME syndrome.



ME/CFS a neurological entity due to head / spine injury or disease - several possibilities ?

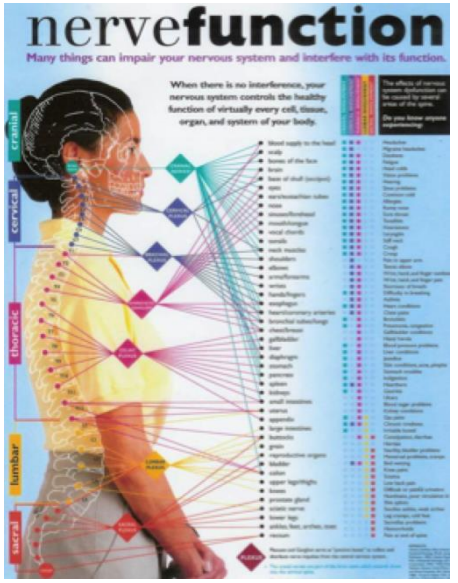
Deranged cerebrospinal fluid (CSF) flow
due to instability and/or mechanical obstruction
in craniocervical junction / cervical spine?

Deranged intracranial pressure due to cerebellar tonsillar ectopia or leakage of CSF

Leakage of neuroinflammatory substances into CSF due to discoligament injuries

Findings pointing to neurological dysfunction/obstruction in the craniocervical area in patients with ME/CFS – overlapping S ?

- Widespread symptoms – from head to foot
- Worse in upright position – better lie down
- Better with neck traction
- Neck/headache
- Sensitizatied nervous system – hypersensitivity
- Gradual development and chronic – like stenosis
- Likens hypoxia
- Long time relation to neurodegenerative diseases
- Lack of local – nociceptive findings in malfunctioning organs
- Lack of detectable biomarkers for infection – so far
- Common in EDS and Whiplash population



En hypotes – flera möjligheter: ME/CFS en neuroinflammatorisk störning av CNS som följd av sjukdom i och/eller trauma mot huvud/halsrygg

Till exempel genom;

Mekaniskt stört flöde av cerebrospinal vätska och/eller ändrat tryck intrakraniellt och/eller i spinalkanal/foramina till följd av instabilitet och/eller obstruktion i kraniocervikal övergång och/eller halsryggen.

Kemisk påverkan på CNS till följd av läckage av neuroinflammatoriska substanser i cerebrospinal vätska som följd av discoligamentär skada eller infektion.

"The Blind Men and the Elephant" by John G. Saxe (read by Tom O'Bedlam)

https://www.youtube.com/watch?v=bJVBQefNXIw&t=25s

Deranged intracranial pressure due to cerebellar tonsillar ectopia or leakage of CSF

Surg Neurol Int. 2016 Dec 26;7(Suppl 42):S1085-S1088. doi: 10.4103/2152-7806.196765. eCollection 2016.

Application of time-spatial labeling inversion pulse magnetic resonance imaging in the diagnosis of spontaneous intracranial hypotension due to high-flow cerebrospinal fluid leakage at C1-2.

Hattori N[1], Inamasu J[1], Nakae S[1], Hirose Y[1], Murayama K[2].

Sultan Qaboos Univ Med J. 2013 Nov;13(4):E611-5. Epub 2013 Nov 8.

Spontaneous intracranial hypotension with magnetic resonance localisation of spinal cerebrospinal fluid leak.

Al-Brashdi YH[1], Raniga S, Revati SR.

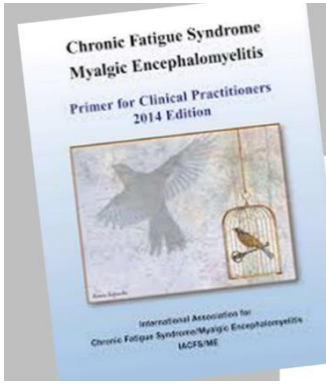
J Headache Pain. 2018 Oct 8;19(1):93. doi: 10.1186/s10194-018-0919-2.

European headache federation guideline on idiopathic intracranial hypertension.

Hoffmann J[1], Mollan SP[2], Paemeleire K[3], Lampl C[4], Jensen RH[5], Sinclair AJ[6].

Assessments at ME-center

- Questionnaries: discomfort drawing, pain drawing, HADS, EQ-5D, RAND-36, MPI-S, KEDS, ME/chronic fatigue syndrom symptom list, Linton ÖMPQ short version, NRS + Shirom Melamed Burnout Questionnaire, a few Bragée clinic specific questionnaries
- Clinical examination of cardiopulmonary system, nervous system, musculosceletal system, Beighton scale for hypermobility etc
- Specific tests: QST, TILT, POTS, PEM
- Radiological exams: brain and cervical spine
- Biomarkers: according to VISS and ME/chronic fatigue syndrom-findings
- Neurologic, psychiatric and other assessments as needed



ASIA

STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

MOTOR

	R	L	KEY MUSCLES
C2			
C3			
C4			
C5			Elbow flexors
C6			Wrist extensors
C7			Elbow extensors
C8			Finger flexors (distal phalanx of middle finger)
T1			Finger abductors (little finger)
T2			
T3			
T4			
T5			
T6			
T7			
T8			
T9			
T10			
T11			
T12			
L1			
L2			Hip flexors
L3			Knee extensors
L4			Ankle dorsiflexors
L5			Long toe extensors
S1			Ankle plantar flexors
S2			
S3			
S4-5			Voluntary anal contraction (Yes/No)

0 = total paralysis
1 = palpable or visible contraction
2 = active movement, gravity eliminated
3 = active movement, against gravity
4 = active movement, against some resistance
5 = active movement, against full resistance
NT = not testable

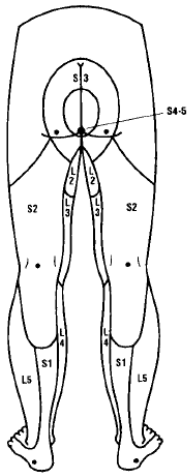
TOTALS ☐ + ☐ = ☐ **MOTOR SCORE**
(MAXIMUM) (50) (50) (100)

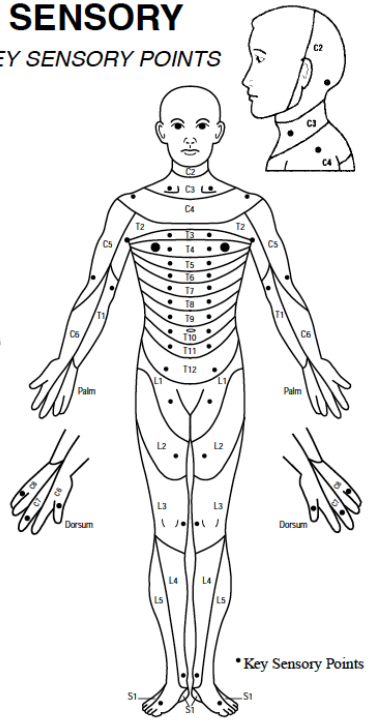
SENSORY

	LIGHT TOUCH R	LIGHT TOUCH L	PIN PRICK R	PIN PRICK L
C2				
C3				
C4				
C5				
C6				
C7				
C8				
T1				
T2				
T3				
T4				
T5				
T6				
T7				
T8				
T9				
T10				
T11				
T12				
L1				
L2				
L3				
L4				
L5				
S1				
S2				
S3				
S4-5				

0 = absent
1 = impaired
2 = normal
NT = not testable

KEY SENSORY POINTS





•Key Sensory Points

☐ Any anal sensation (Yes/No)

TOTALS ☐ + ☐ = ☐ **PIN PRICK SCORE** (max: 112)
= ☐ **LIGHT TOUCH SCORE** (max: 112)
(MAXIMUM) (56) (56) (56) (56)

NEUROLOGICAL LEVEL
The most caudal segment with normal function
SENSORY R ☐ L ☐
MOTOR R ☐ L ☐

COMPLETE OR INCOMPLETE? ☐
Incomplete = Any sensory or motor function in S4-S5

ASIA IMPAIRMENT SCALE ☐

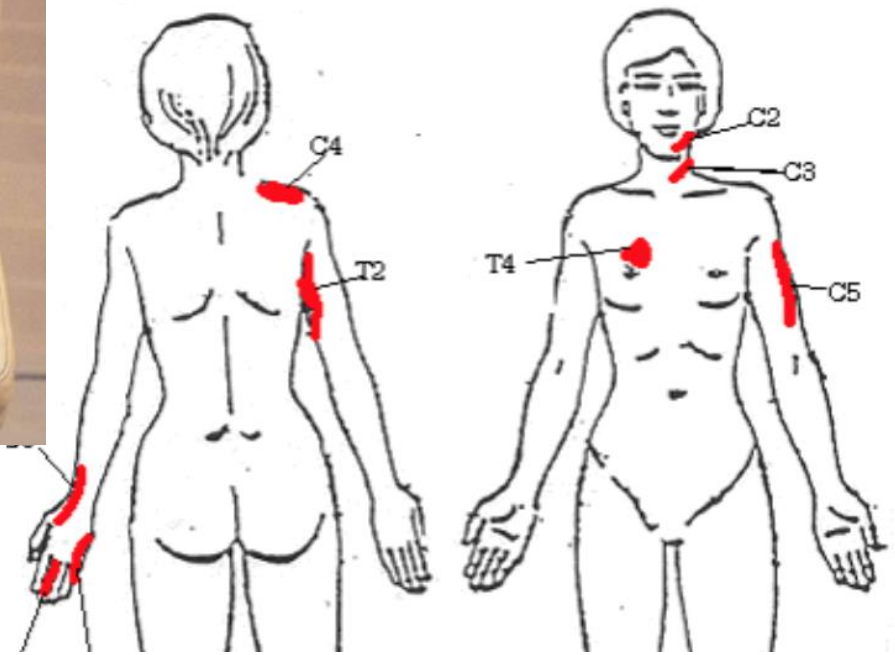
ZONE OF PARTIAL PRESERVATION
Caudal extent of partially innervated segments
SENSORY R ☐ L ☐
MOTOR R ☐ L ☐

2000 Rev.

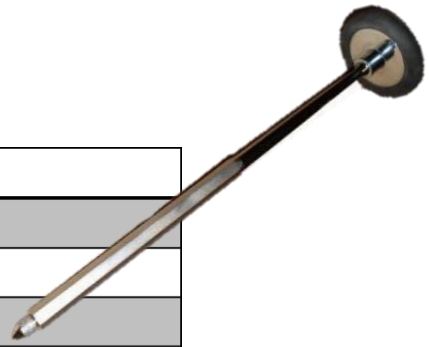
Sensory tests
- to touch and pain

Wartenberg wheel – bimanual testing!

Indicator areas



Reflexes



Nerve level	Stretch reflex
C4	Supraspinatus reflex
C5	Biceps reflex
C6	Brachioradialis reflex
C7	Triceps reflex
L4	Patella reflex

Motor strength

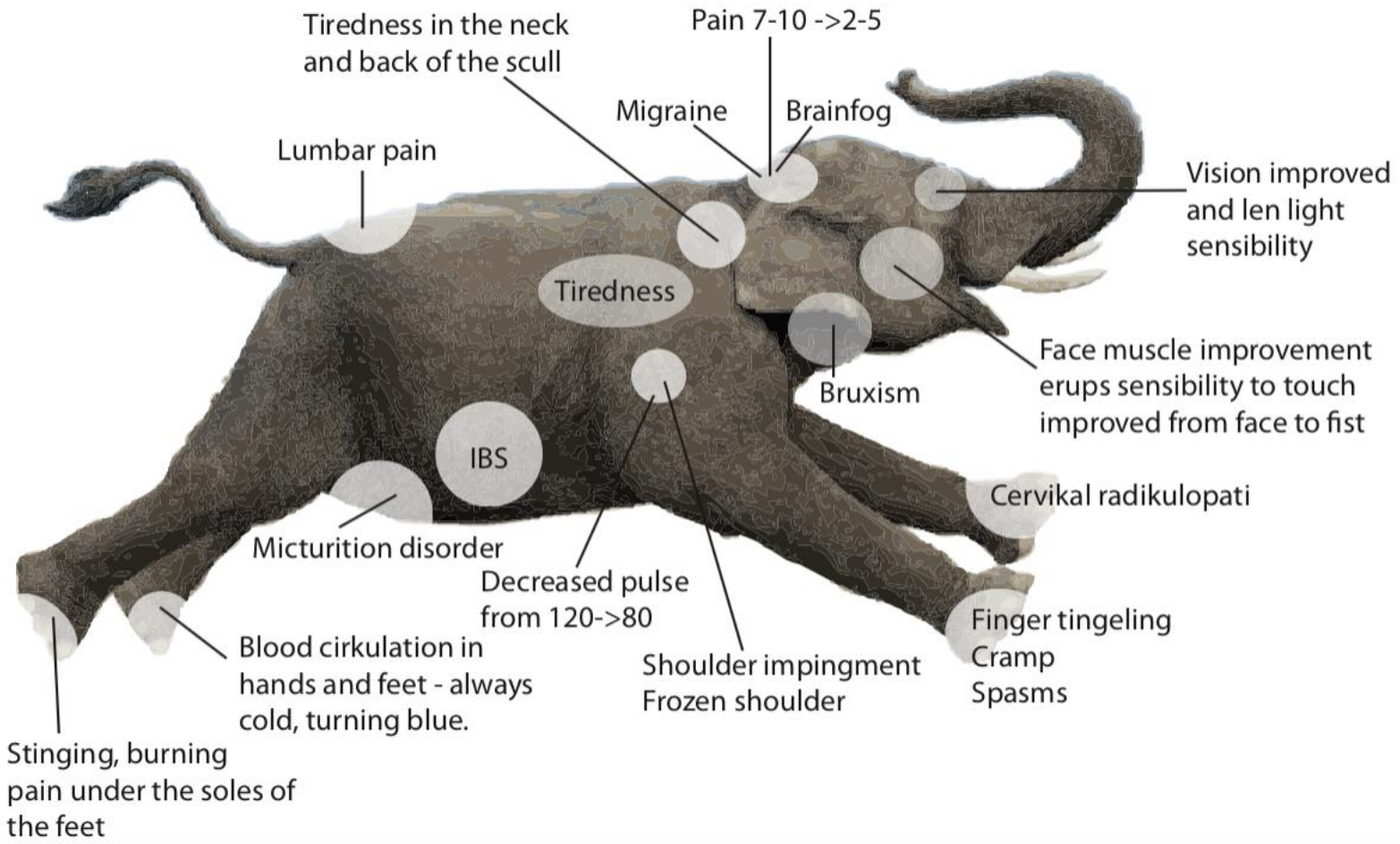
Motor function	Normal strength	Weakness
Neck flexion (C2)		Left / Right
Neck extension (C3)		Left / Right
Side flexion of the neck		Left / Right
Neck rotation		Left / Right
Shoulder elevation (C4)		Left / Right
Arm abduction (C5)		Left / Right
Elbow flexion (C6)		Left / Right
Elbow extension (C7)		Left / Right
Wrist flexion (C8)		Left / Right
Finger adduction (Th1)		Left / Right

Palpation
spinous process + paravertebral

Neck compression

Neck traction

A recent patient report – symptom relief after cervical spine surgery



Spinal cord neurons sensitized in chronic pain after whiplash injury and in fibromyalgia, Banic et al. Pain 2003

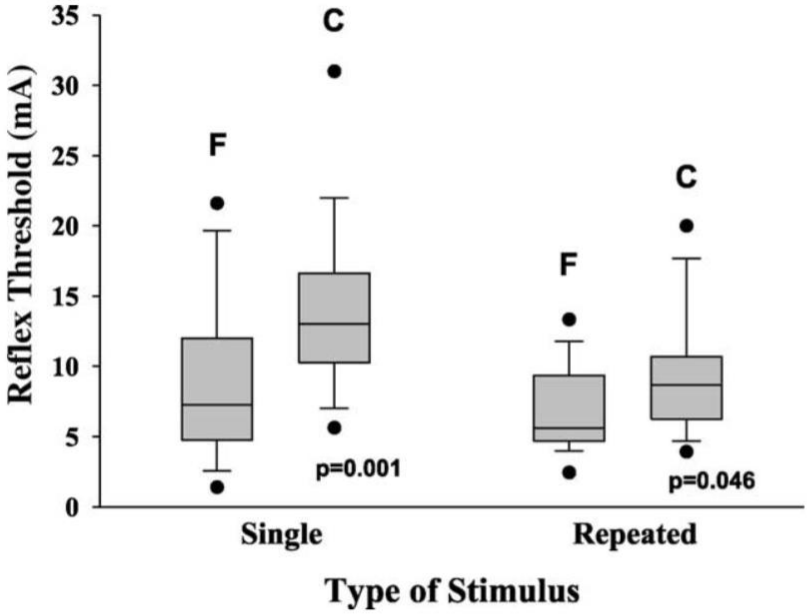


Fig. 2. Reflex threshold in fibromyalgia patients as compared to the control group. W, whiplash group; C, control group. *X*-axis: 'single' represents a single electrical stimulus threshold; 'repeated', the repeated electrical stimulus threshold (five stimuli at 2 Hz). Data are presented as median, 10th, 25th, 75th and 90th percentiles. The black dots represent the values that lie outside the 10th and 90th percentiles.

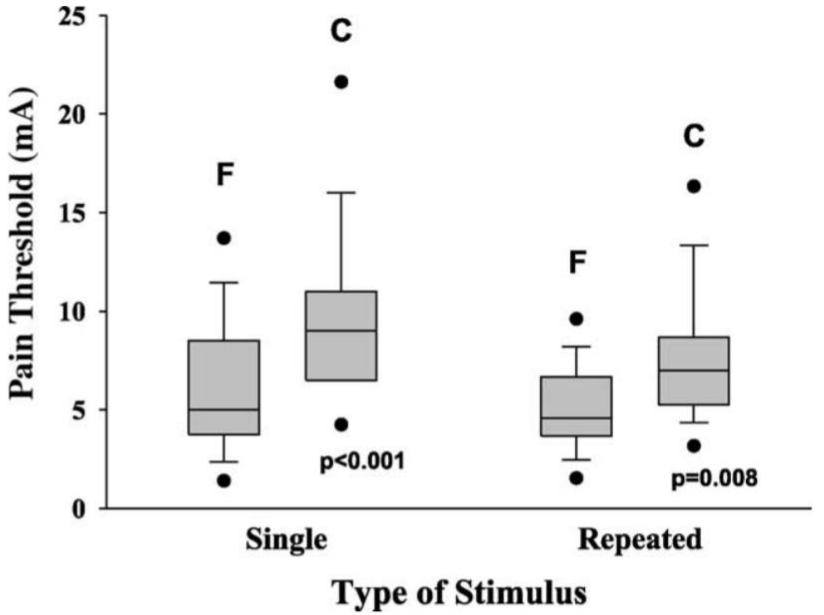
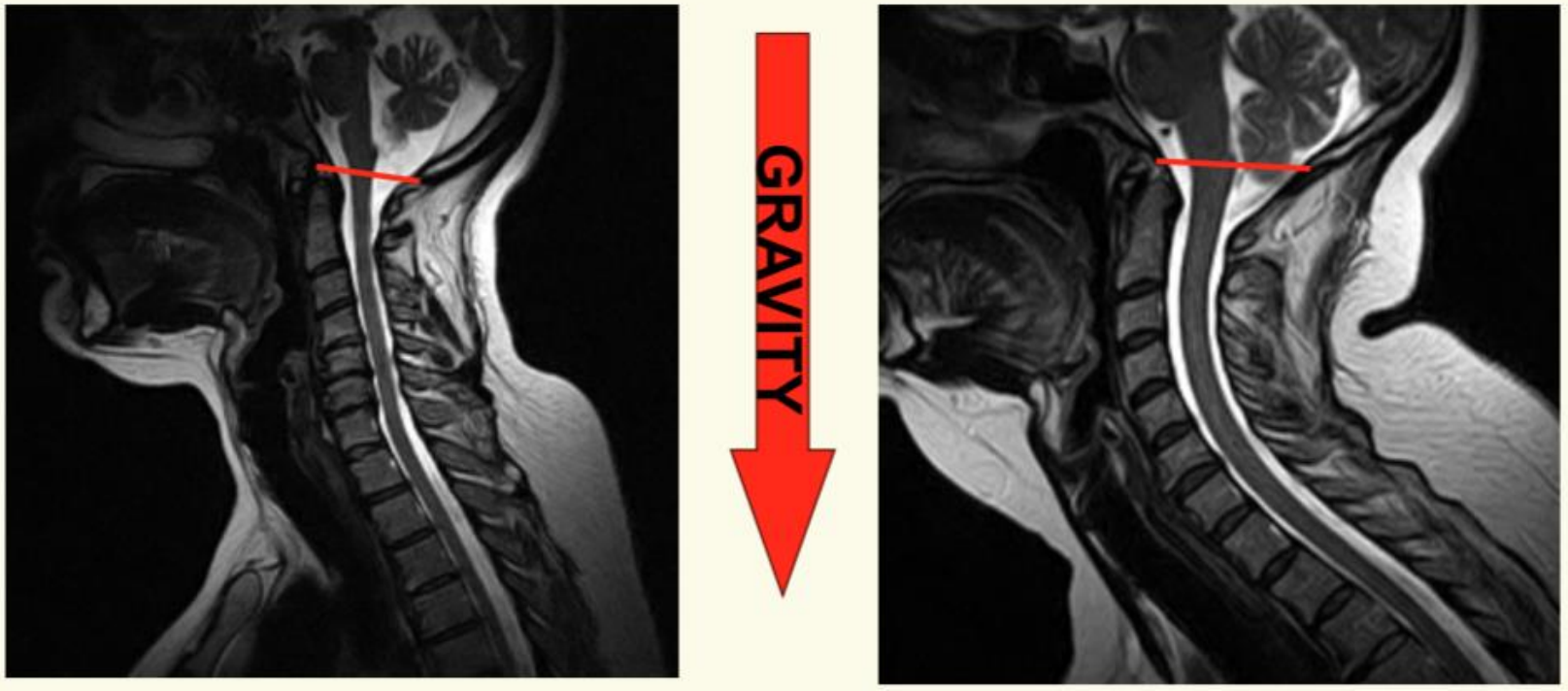


Fig. 4. Pain threshold in fibromyalgia patients as compared to the control group. W, whiplash group; C, control group. *X*-axis: 'single' represents a single electrical stimulus threshold; 'repeated', the repeated electrical stimulus threshold (five stimuli at 2 Hz). Data are presented as median, 10th, 25th, 75th and 90th percentiles. The black dots represent the values that lie outside the 10th and 90th percentiles.

Why upright MRI ?

Cerebellar Tonsils

Professor F. W. Smith, University of Aberdeen, Scotland



Case Study

Case courtesy of J.P. Elsig, M.D.
Zurich, Switzerland

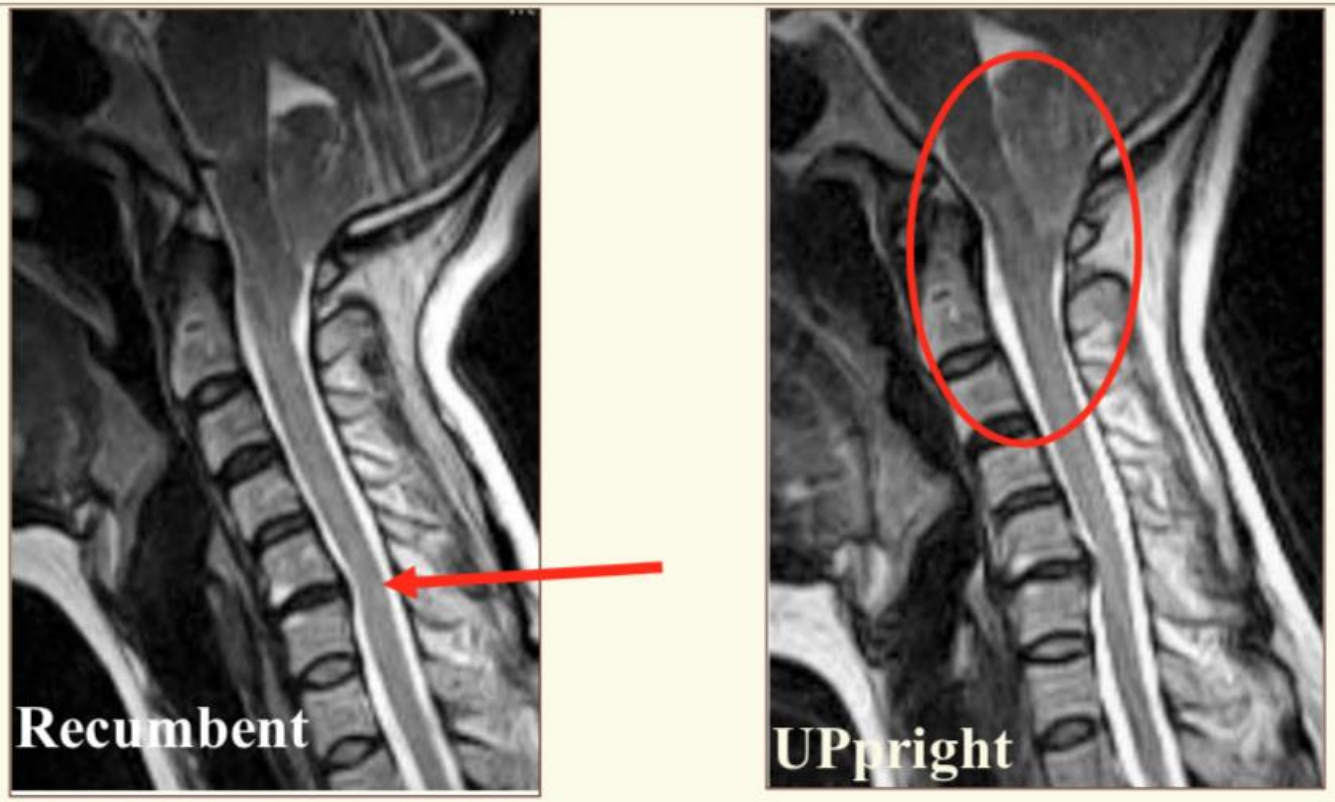
A 50-year-old woman had been suffering for years from neck pain. A prior recumbent MRI had shown a C5-6 disc degeneration with a posterior bulge and a moderate segmental kyphosis.

Despite repeated attempts with conservative treatment, the patient's symptoms worsened and were marked by the onset of:

- ✓ ***transient paresthesia***
- ✓ ***transient loss of muscle tone in the legs***
- ✓ ***drop attacks***

Which could **not** be explained by the disc bulge.

The recumbent cervical MRI shows a C5-6 disc bulge in a patient with neck pain which sometimes radiates to the arms



The **UPRIGHT** MRI shows a position-related downward herniation (Chiari I malformation) with compression of the brain stem. This correlates with the additional complaints of dizziness and occasional drop attacks when bending forward.

Professor F. W. Smith, University of Aberdeen, Scotland

Rivista di Neuroradiologia 14: 45-54, 2001

Limitation of Functional MRI of the Cervical Spine in Supine Position

M. ORSZAGH, J. HENNIG*, D. KAECH**, K-H. ALLMANN***,
D. M.SCHULTE****, J. HUDEC*****, J. ZENTNER******

*Section for Neuroradiology; * Section for Imaging and Functional Medical Physics; *** Department of Diagnostic Radiology; Radiological Clinic, University of Freiburg, Germany*
*** Neurosurgical Department; Kantonspital, Chur, Swiss*
**** Neurosurgical Departement; Philipps-University Marburg, Germany*
***** State Rehabilitation Centre; Kovacova, Slovakia*
****** Neurosurgical Clinic; University of Freiburg, Germany*

Examination in the supine position are highly problematic for the assessment of functional defects in the cervical spine…..

Therefore **examination in the upright position appears to be mandatory**. A neutral, self-controlled up-right position, in which the gravitational force is actively balanced should be the starting point for motional examinations. At the same time high spatial and temporal resolution are necessary to study the detailed motional displacement of the relevant structures.

Why upright MRI

Functional methods for examination of the cervical spine are always **indicated when** it is to be expected that pathological changes can only be recognized in function posture. This is especially the case when:

1. the basis, nature and extent of an instability is to be clarified; (a) bony, b) discoligamentary (posttraumatic, degenerative, inflammatory, neo-plastic)) and the benefits of stabilizing measures are to be considered with respect to the biomechanical situation
2. there are **movement and exercise-dependent symptoms** (functional stenoses in listesis, threatening herniated disk, etc)
3. there is **discrepancy between the clinical symptoms and the static radiological findings**
4. the morphological correlate is sought in the presence of vertebrobasiliary insufficiency

Orszagh, M et al. The Neuroradiology Journal, 2001

Discrepancies of MRI findings between recumbent and upright positions in atlantoaxial lesion. Report of two cases

Suzuki et al. European Spine Journal, 2008, Vol.17(Supplement 2), pp.304-307

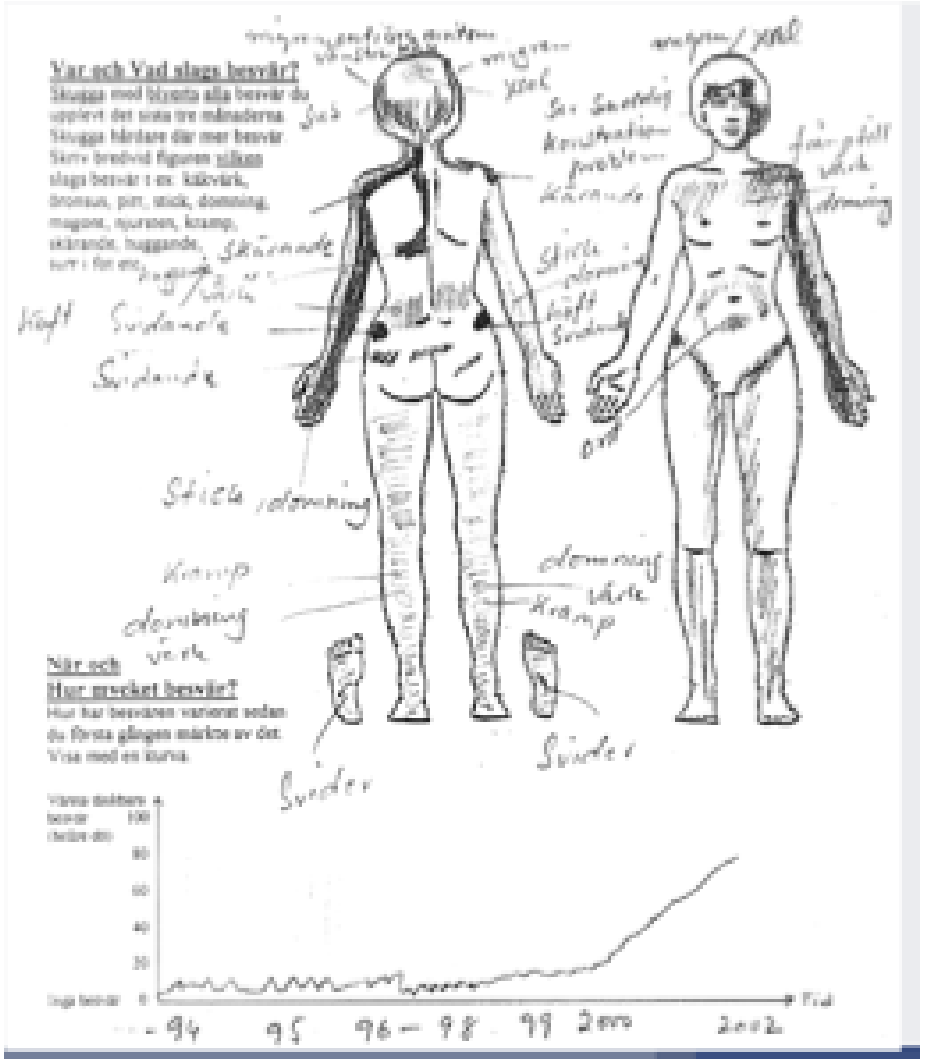
A typical case – 35 year old train driver

- Family father and runner, 0 sick leave

- Train brake failure – hit stop – WL + hit head
- Neck-shoulder pain, vertigo, nausea
- Emergency journal entry ”…small bump in forehead, no neurologicial signs, tender neck muscle, free spine movement….”stretched muscle….pain killer”
- Patient experience –”The Dr pinched my neck and offered pain killer, I felt humiliated”

The Train driver 20+ years later

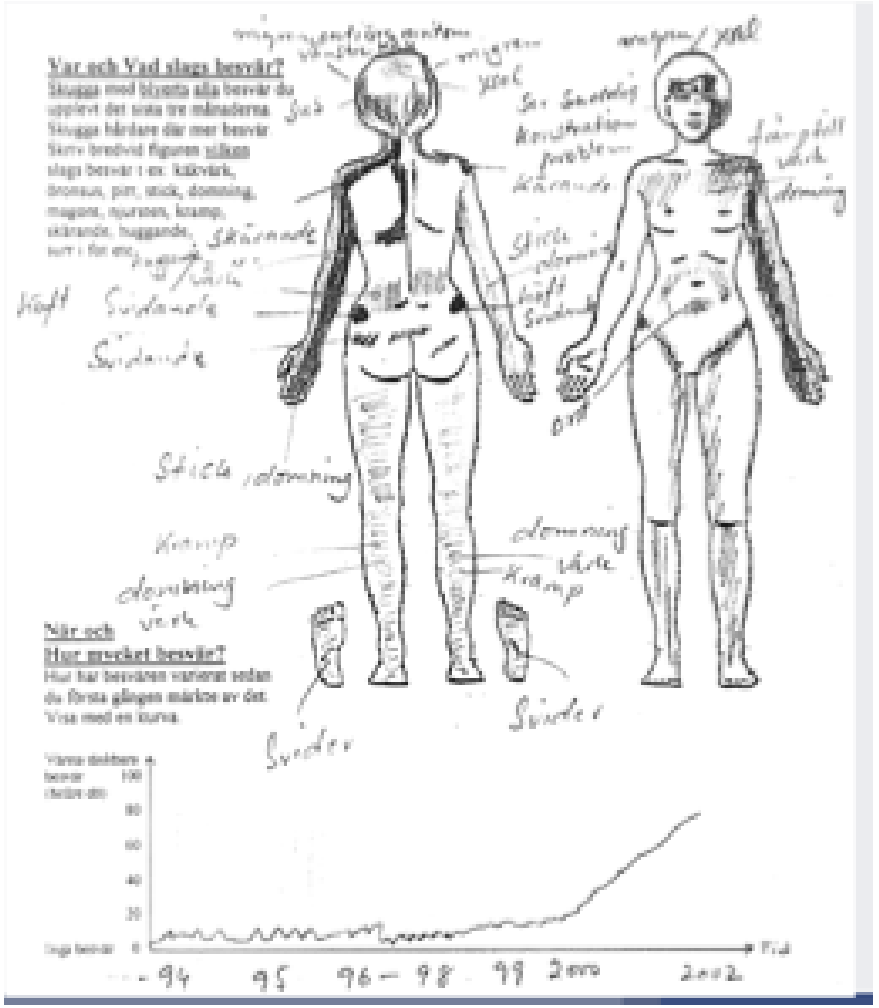
- After hundreds of clincians and thousands of visits
- Diagnose still ”Muscle inflammation”
- Worse after each physio session
- Out of work
- No compensation
- No sign of nerv involvement on MRI
- Yet …..complete Discomfort drawing indicates !?



The Train driver 20+ years later

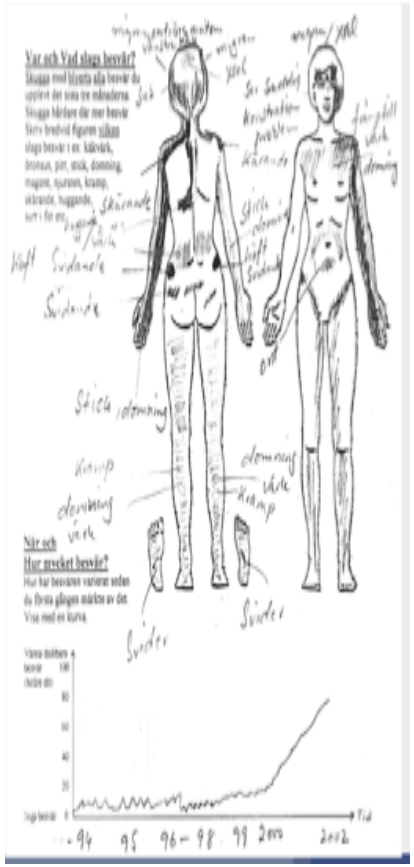
Physical exam findings:

- Hypotrophy left side from neck to arm and torso
- RoM severly restricted - positiv Speurling wo pressure
- Hyperreflexi C4-L4
- Sensibility to touch and pain deranged left side from chin to foot – allodynia
- Muscle strength decreased
- Impingment left shoulder – released autotraktion slight neck traction



The Train driver 20 years later. What is the truth – muscle or nerve involvement?

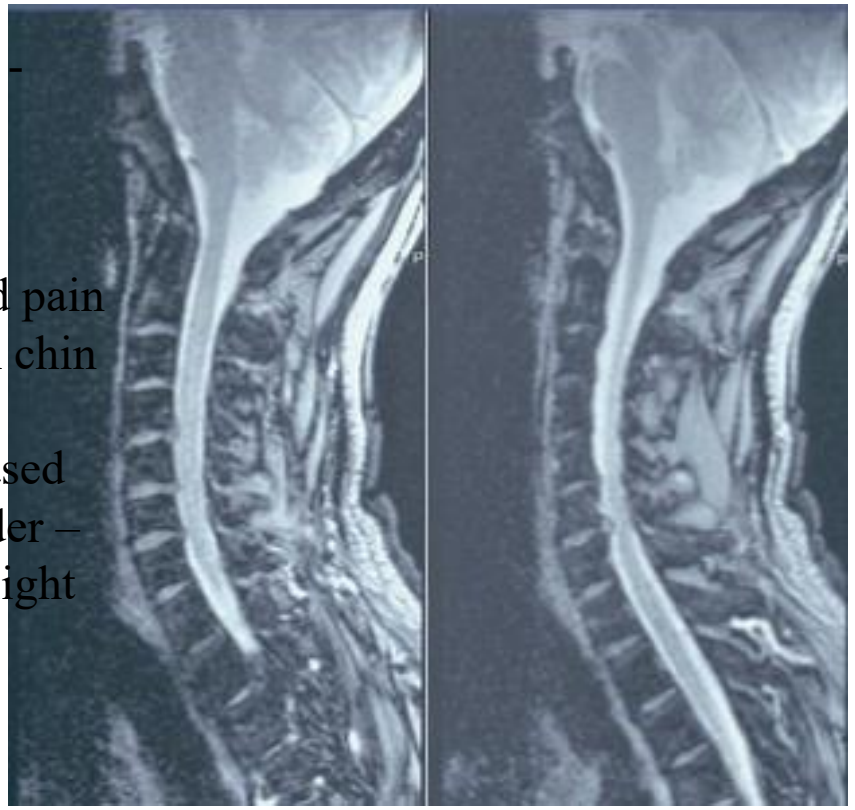
The drawing ?



The physical exam ?

- Hypotrophy left side from neck to arm and torso
- RoM severly restricted - positiv Speurling wo pressure
- Hyperreflexi C4-L4
- Sensibility to touch and pain deranged left side from chin to foot – allodynia
- Muscle strength decreased
- Impingment left shoulder – released autotraktion slight neck traction

The standard MRI ? (assessment of)



Leakage of neuroinflammatory substances into CSF due to discoligament injuries

Buskila D, Neumann L, Vaisberg G, Alkalaly D, Wolfe F. Increased rates of fibromyalgia following cervical spine injury. A controlled study of 161 cases of traumatic injury. Arthritis and Rheumatism 1997;40:446–452.

McLean SA, William DA, Clauw DJ. Fibromyalgia after motor vehicle collision: Evidence and implications. Traffic Injury Prevention 2005;6:97–104.

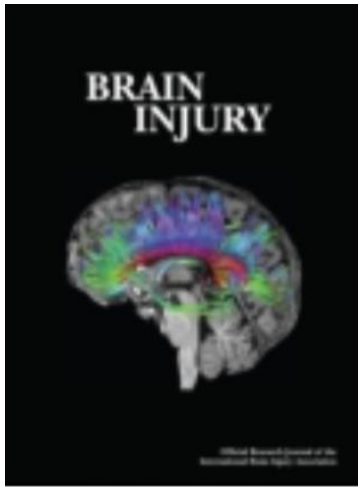
A case-control study of cerebellar tonsillar ectopia (Chiari) and head/neck trauma (whiplash)

Abstract

Primary objective: Chiari malformation is defined as herniation of the cerebellar tonsils through the foramen magnum, also known as cerebellar tonsillar ectopia (CTE). CTE may become symptomatic following whiplash trauma. The purpose of the present study was to assess the frequency of CTE in traumatic vs non-traumatic populations.

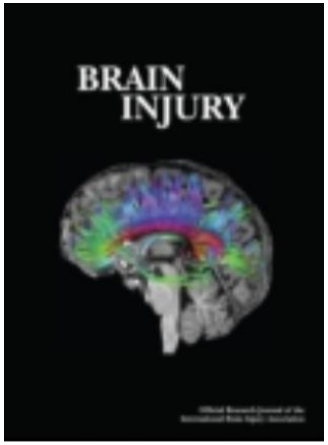
Study design: Case-control.

Methods and procedures: Cervical MRI scans for 1200 neck pain patients were reviewed; 600 trauma (cases) and 600 non-trauma (controls). Half of the groups were scanned in a recumbent position and half were scanned in an upright position. Two radiologists interpreted the scans for the level of the cerebellar tonsils.



- Freeman et al, Brain Injury, 2010, 24:7-8, 988-994

A case-control study of cerebellar tonsillar ectopia (Chiari) and head/neck trauma (whiplash)



Main outcomes and results
A total of 1195 of 1200 scans were read. CTE was found in 5.7% and 5.3% in the recumbent and upright non-trauma groups vs 9.8% and 23.3% in the recumbent and upright trauma groups (p=0.0001).

Conclusions
The results described in the present investigation are first to demonstrate a neuroradiographic difference between neck pain patients with and without a recent history of whiplash trauma. The results of prior research on psychosocial causes of chronic pain following whiplash are likely confounded because of a failure to account for a possible neuropathologic basis for the symptoms.

- Freeman et al, Brain Injury, 2010, 24:7-8, 988-994

Rivista di Neuroradiologia 14: 45-54, 2001

Limitation of Functional MRI of the Cervical Spine in Supine Position

M. ORSZAGH, J. HENNIG*, D. KAECH**, K-H. ALLMANN***,
D. M.SCHULTE****, J. HUDEC*****, J. ZENTNER******

*Section for Neuroradiology; * Section for Imaging and Functional Medical Physics; *** Department of Diagnostic Radiology; Radiological Clinic, University of Freiburg, Germany*
*** Neurosurgical Department; Kantonspital, Chur, Swiss*
**** Neurosurgical Departement; Philipps-University Marburg, Germany*
***** State Rehabilitation Centre; Kovacova, Slovakia*
****** Neurosurgical Clinic; University of Freiburg, Germany*

Examination in the supine position are highly problematic for the assessment of functional defects in the cervical spine…..

Therefore **examination in the upright position appears to be mandatory**. A neutral, self-controlled up-right position, in which the gravitational force is actively balanced should be the starting point for motional examinations. At the same time high spatial and temporal resolution are necessary to study the detailed motional displacement of the relevant structures.

Why upright MRI

Functional methods for examination of the cervical spine are always **indicated when** it is to be expected that pathological changes can only be recognized in function posture. This is especially the case when:

1. the basis, nature and extent of an instability is to be clarified; (a) bony, b) discoligamentary (posttraumatic, degenerative, inflammatory, neo-plastic)) and the benefits of stabilizing measures are to be considered with respect to the biomechanical situation
2. there are **movement and exercise-dependent symptoms** (functional stenoses in listesis, threatening herniated disk, etc)
3. there is **discrepancy between the clinical symptoms and the static radiological findings**
4. the morphological correlate is sought in the presence of vertebrobasiliary insufficiency

Orszagh, M et al. The Neuroradiology Journal, 2001

Discrepancies of MRI findings between recumbent and upright positions in atlantoaxial lesion. Report of two cases

Suzuki et al. European Spine Journal, 2008, Vol.17(Supplement 2), pp.304-307

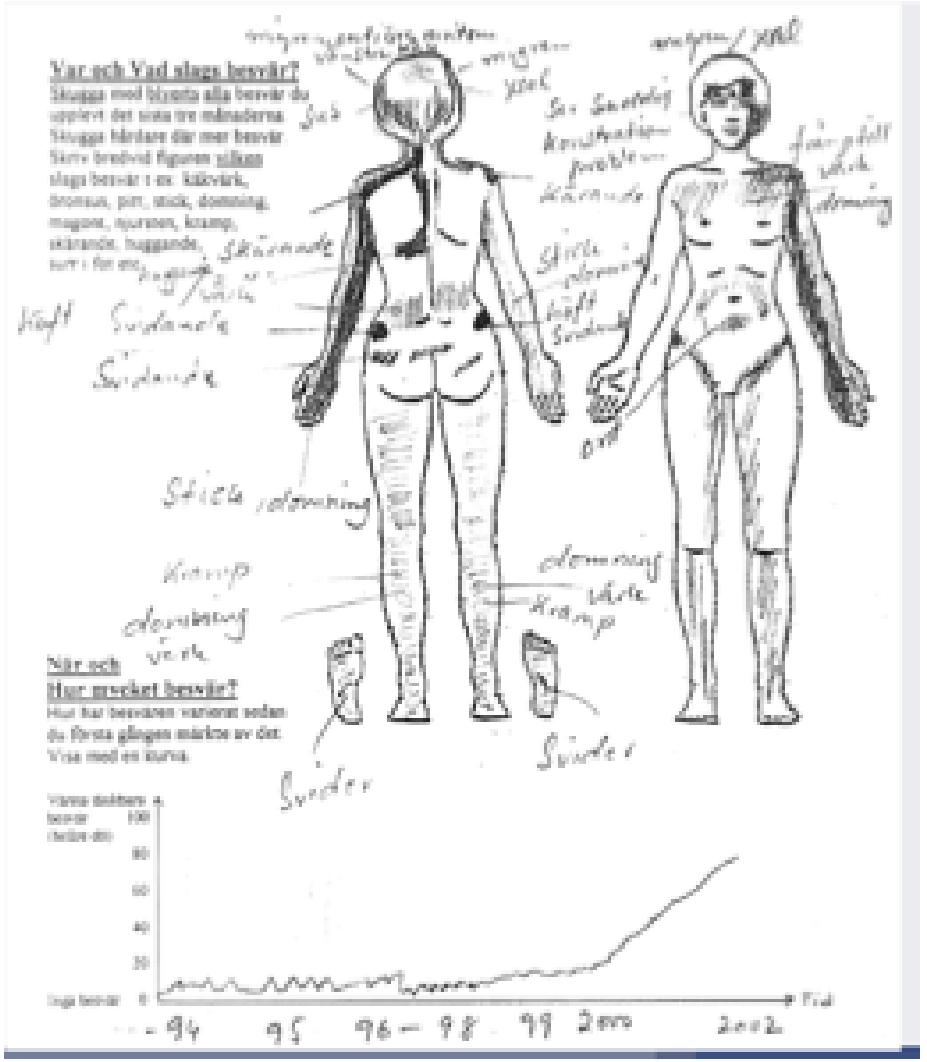
A typical case – 35 year old train driver

- Family father and runner, 0 sick leave

- Train brake failure – hit stop – WL + hit head
- Neck-shoulder pain, vertigo, nausea
- Emergency journal entry ”…small bump in forehead, no neurologicial signs, tender neck muscle, free spine movement….”stretched muscle….pain killer”
- Patient experience –”The Dr pinched my neck and offered pain killer, I felt humiliated”

The Train driver 20+ years later

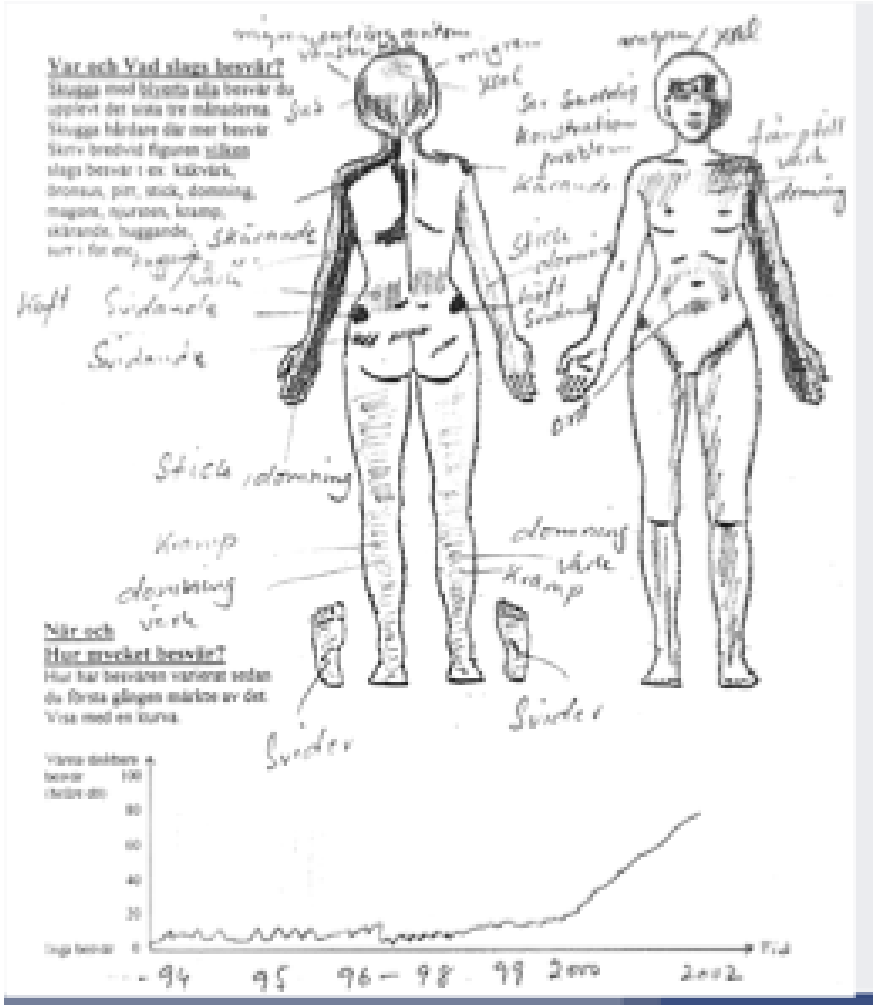
- After hundreds of clincians and thousands of visits
- Diagnose still ”Muscle inflammation”
- Worse after each physio session
- Out of work
- No compensation
- No sign of nerv involvement on MRI
- Yet …..complete Discomfort drawing indicates !?



The Train driver 20+ years later

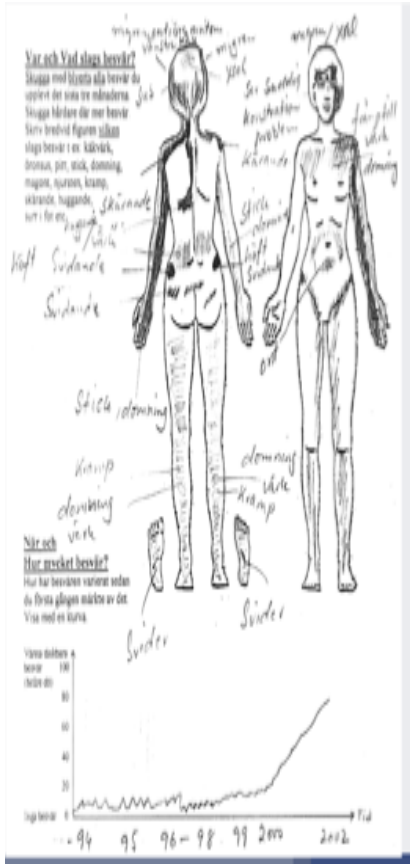
Physical exam findings:

- Hypotrophy left side from neck to arm and torso
- RoM severly restricted - positiv Speurling wo pressure
- Hyperreflexi C4-L4
- Sensibility to touch and pain deranged left side from chin to foot – allodynia
- Muscle strength decreased
- Impingment left shoulder – released autotraktion slight neck traction



The Train driver 20 years later. What is the truth – muscle or nerve involvement?

The drawing ?

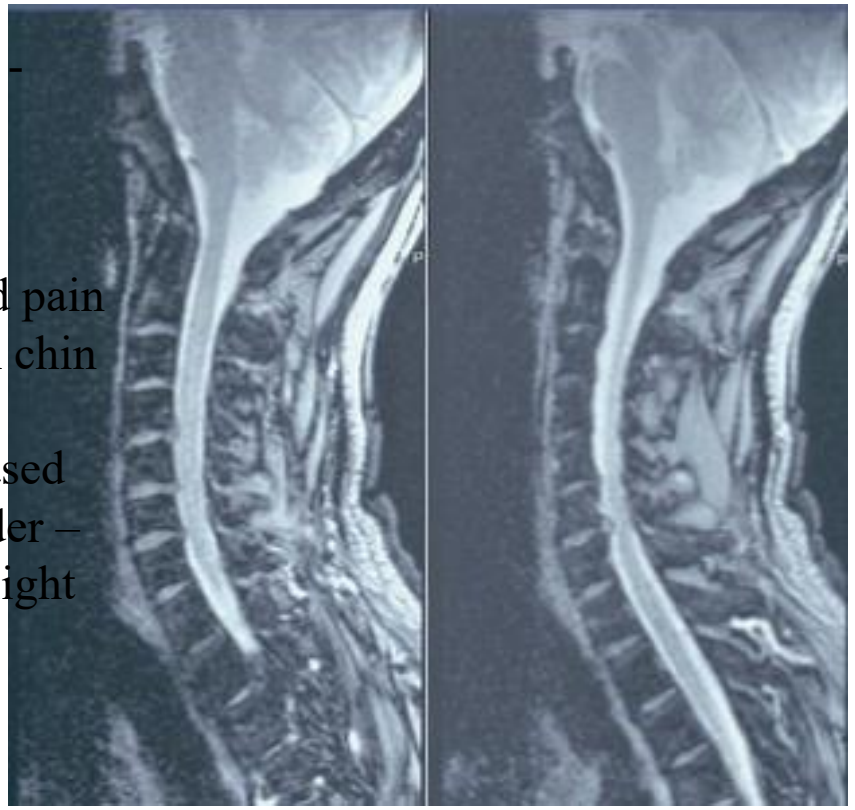


The physical exam ?

- Hypotrophy left side from neck to arm and torso
- RoM severly restricted - positiv Speurling wo pressure
- Hyperreflexi C4-L4
- Sensibility to touch and pain deranged left side from chin to foot – allodynia
- Muscle strength decreased
- Impingment left shoulder – released autotraktion slight neck traction

The standard MRI ?

(assessment of)



Leakage of neuroinflammatory substances into CSF due to discoligament injuries

Buskila D, Neumann L, Vaisberg G, Alkalaly D, Wolfe F. Increased rates of fibromyalgia following cervical spine injury. A controlled study of 161 cases of traumatic injury. Arthritis and Rheumatism 1997;40:446–452.

McLean SA, William DA, Clauw DJ. Fibromyalgia after motor vehicle collision: Evidence and implications. Traffic Injury Prevention 2005;6:97–104.