

day, January 12, 2018
Balgrist University Hospital, Zurich

Interdisciplinary Symposium - Complex Spine Symposium - Cervical Spine

Hosts/Faculty

Kuniyoshi Abumi, MD, Professor, President, Sapporo Orthopaedic Hospital-Center,
for Spinal Disorders, Japan

Armin Curt, MD, FRCPC, Professor and Chairman Spinal Cord Injury Center,

Balgrist University Hospital

Mazda Farshad, MD, MPH, Professor and Chairman Orthopedic Surgery, Chief
Spine, Medical Director, Balgrist University Hospital

Michael G. Fehlings, MD, PhD, FRCS(C), FACS, University of Toronto

Christoph Josten, MD, Professor and Director of the Leipzig University Hospital

Hans-Christoph Pape, MD, FACS, Professor and Chairman Traumatology, Universi-
ty Hospital Zurich

Christian Pfirrmann, MD, Professor and Chief of Radiology, Balgrist University
Hospital

Luca Regli, MD, PhD, Professor and Chairman of Neurosurgery, University of Zurich



Program, Friday, January 12, 2018

8:00	Commercial Exhibit in the Lobby								
Myelopathy									
8:30	Introduction: Degenerative cervical myelopathy	M. Farshad							
8:50	Anterior approaches and surgical techniques in treatment of myelopathy	M.G. Fehlings							
9:10	Posterior approach in treatment of myelopathy caused by CSM or OPLL	K. Abumi							
9:30	Advanced assessments in cervical myelopathy	A. Curt							
9:50	<i>Coffee Break</i>								
10.30	Upper Cervical Spine Trauma	C. Josten	14.00	Case presentation 1					
10.50	Lower Cervical Spine Trauma	H. Pape	14.15	Case presentation 2					
11.10	Complex Cervical Trauma treatment	M.G. Fehlings	14.30	Case presentation 3					
	Spine Trauma Complexities		14.45	Case presentation 4					
11.30	Intradural cervical tumors	L. Regli	15.00	Case presentation 5					
11.50	Cervical and cervicothoracic deformities	K. Abumi	15.15	Q&A					
12:10	<i>Lunch</i>		15.45	<i>End of Symposium</i>					

DEGENERATIVE CERVICAL MYELOPATHY CLINICAL DECISION MAKING

Prof. Dr. Mazda Farshad

Chair of Orthopedic Surgery

Chief of Spine Surgery

Medical Director

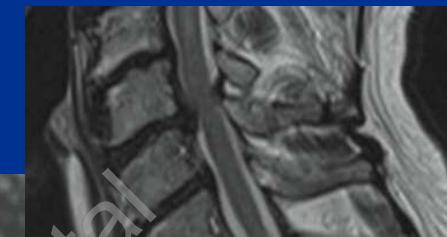
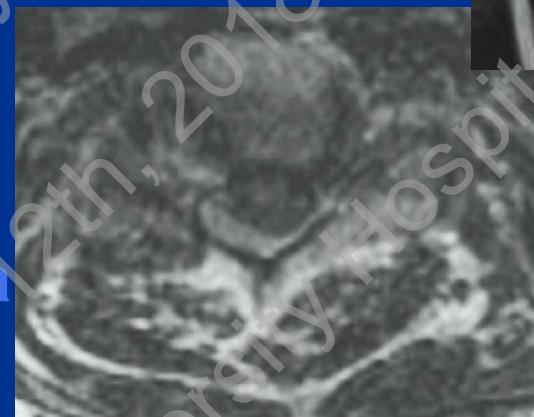
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CERVICAL MYELOPATHY - CAUSES

- degenerative cervical spondylosis
- acute disc hernia
- neoplastic
- infections: epidural abscess
- trauma
- deformity: cervical kyphosis
- neurologic injury (ischemic etc..)
- systemic: OPLL, RA, etc..

CERVICAL MYELOPATHY - CAUSES

- **degenerative cervical spondylosis**
- **acute disc hernia**
- **neoplastic**
- **infections: epidural a**
- **trauma**
- **deformity: cervical kyphosis**
- **neurologic injury (ischemic etc..)**
- **systemic: OPLL, RA, etc..**



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CERVICAL MYELOPATHY CLINICAL DECISION MAKING

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what to do?

CERVICAL MYELOPATHY CLINICAL DECISION MAKING

STOPP!
we need more information!



CERVICAL MYELOPATHY

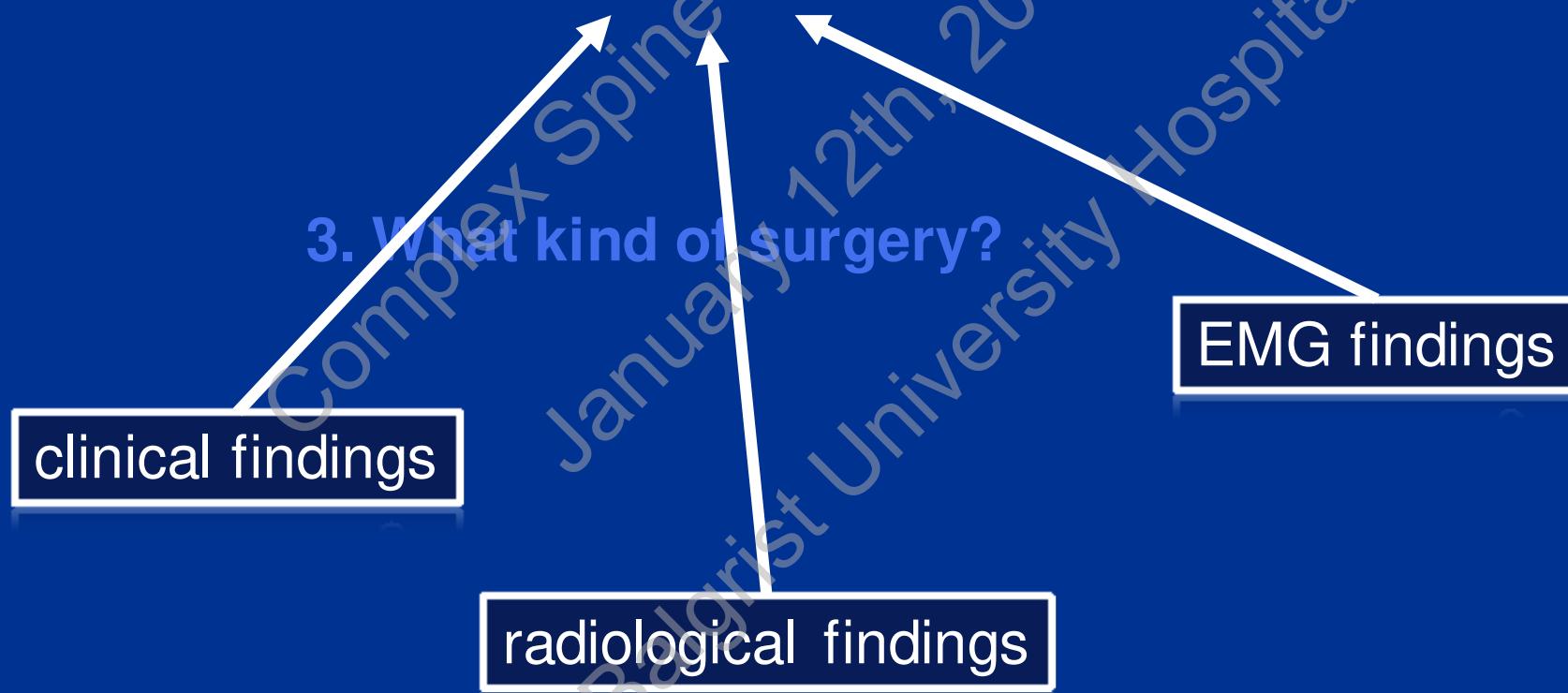
CLINICAL DECISION MAKING

- 1. Who needs surgery?**
- 2. Who will do well with surgery ?**
- 3. What kind of surgery?**

CERVICAL MYELOPATHY

CLINICAL DECISION MAKING

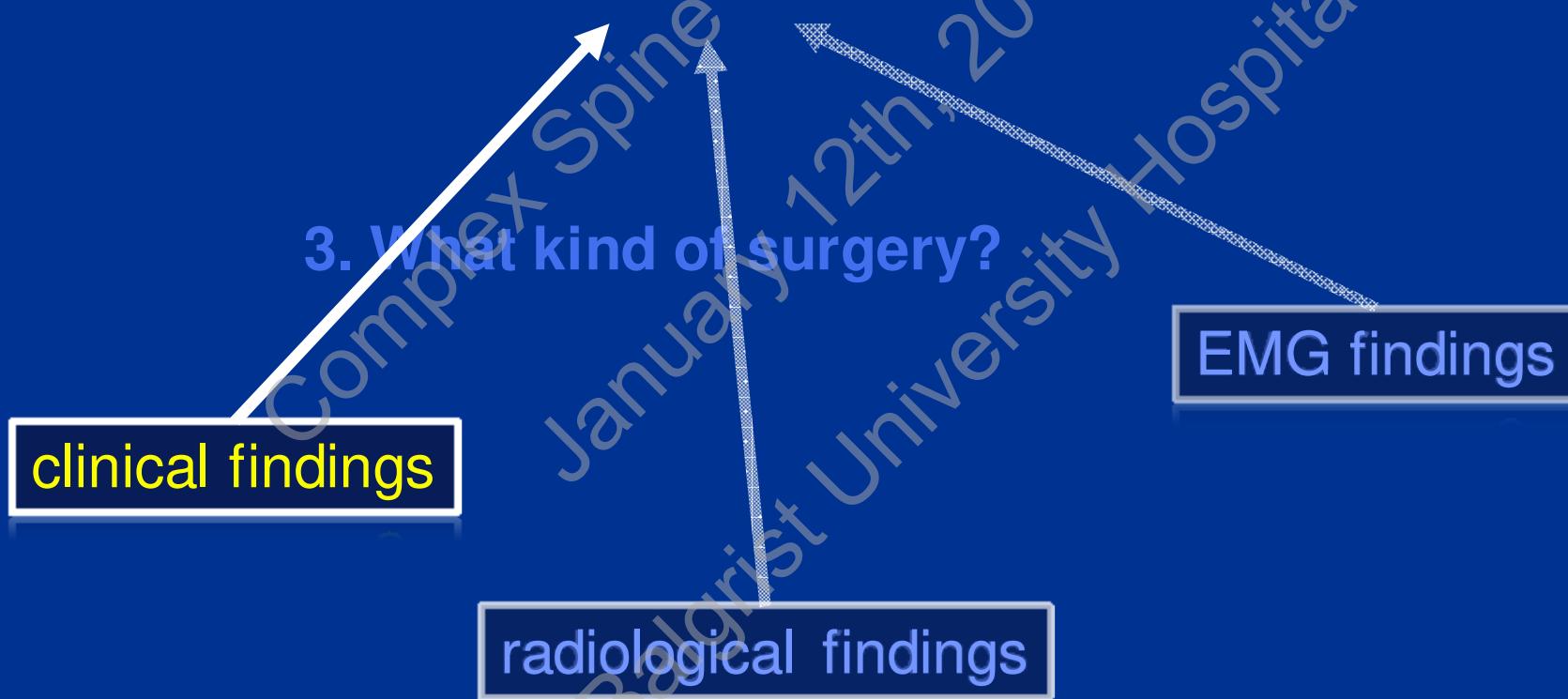
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CERVICAL MYELOPATHY

CLINICAL DECISION MAKING

1. Who needs surgery?
2. Who will do well with surgery ?



CERVICAL MYELOPATHY

CLINICAL FINDINGS

- **neck pain and stiffness**
- **extremity paresthesia**
 - diffuse non-dermatomal numbness and tingling
- **weakness and clumsiness**
 - weakness and decreased manual dexterity (dropping objects, difficulty manipulating fine objects)
- **gait instability**
 - gait changes are most important clinical predictor
- **(urinary retention)**
 - rare and only appear late in disease progression

CERVICAL MYELOPATHY CLINICAL FINDINGS

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CERVICAL MYELOPATHY PHYSICAL EXAM

MOTOR: weakness, finger escape sign

SENSORTIC: dysfunction in proprioception (dorsal column)
decreased pain sensation (spino-thalamic)

UPPER MOTOR NEURON:

- hyperreflexia
- inverted radial reflex
- Hoffmans' sign
- sustained clonus (>3)
- Babinsky

GAIT AND BALANCE: walk, Romberg test

CERVICAL MYELOPATHY PHYSICAL EXAM

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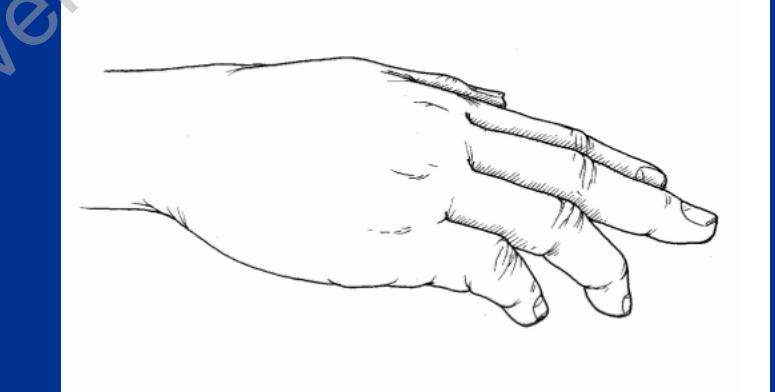
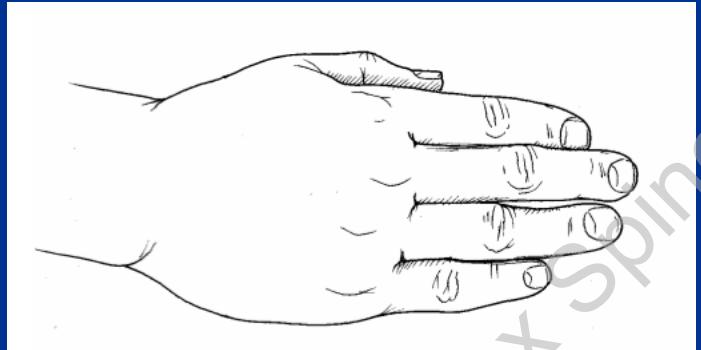
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GAIT AND BALANCE: walk, Romberg test

FINGER ESCAPE SIGN



1 min

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PHYSICAL EXAM

MOTOR: weakness, finger escape sign

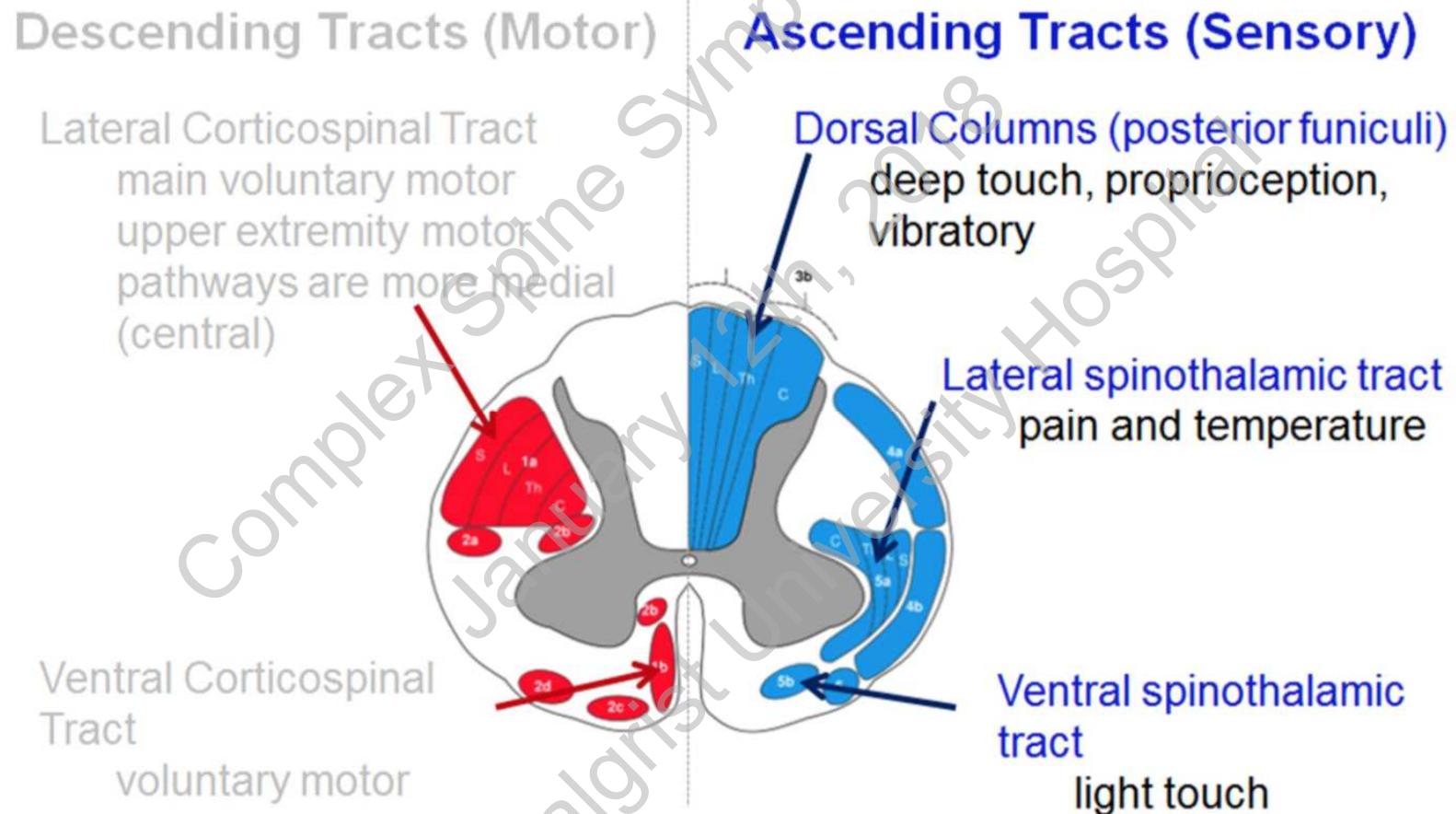
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PHYSICAL EXAM ANATOMICAL BACKGROUND



PHYSICAL EXAM

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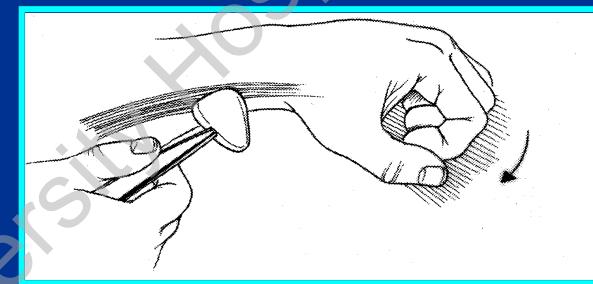
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Babinsky



GAIT AND BALANCE: walk, Romberg test

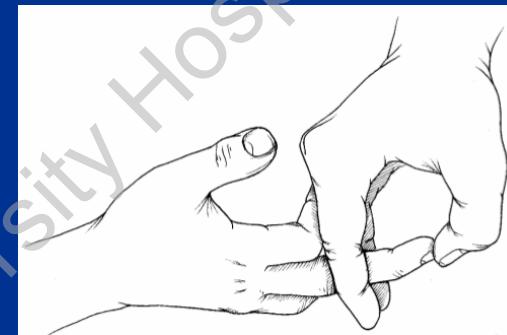
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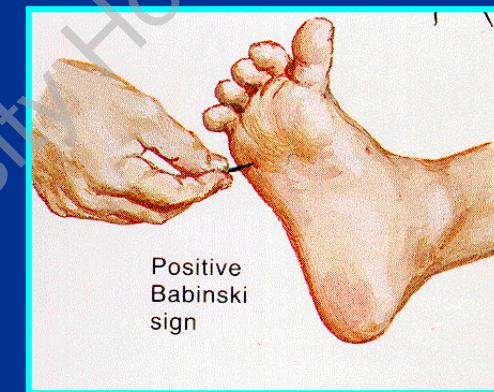
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inverted radial reflex

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GAIT AND BALANCE: walk, Romberg test

PHYSICAL EXAM

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UPPER MOTOR NEURON:

hyperreflexia

inverted radial reflex

Hoffmans' sign

sustained clonus (>3)

Babinsky

GAIT AND BALANCE: walk, Romberg test



PHYSICAL EXAM

Jaw-jerk reflex:



- a stretch reflex of the masseter & temporalis muscles
- Brisk reflex suggests etiology **above foramen magnum**
- Absent reflex suggest abnormality of CN - V

PHYSICAL EXAM



Table 1. Clinical Signs Present in Myelopathic Patients

Clinical Sign	No. Patients	% of Patients	Standard Error
Gait abnormality	49	90.74%	3.94%
Any hyperreflexia (LE or UE)	46	85.19%	4.83%
Hoffman	45	83.33%	5.07%
LE hyperreflexia	44	81.48%	5.29%
Cross-abductor	41	75.93%	5.82%
UE hyperreflexia	36	66.67%	6.42%
Babinski	24	44.44%	6.76%

CERVICAL MYELOPATHY CLINICAL DECISION MAKING

PE: neck pain, mild ataxia,
hyperreflexia



what to do?

Predictors of Surgical Outcome in Cervical Spondylotic Myelopathy

Alina Karpova, MSc,*† Ranganathan Arun, DM, FRCS (Tr&Orth), PGDip (Orth Engin), MRCS,*†
Aileen M. Davis, PhD,‡ Abhaya V. Kulkarni, MD, PhD,§ Eric M. Massicotte, MD, MSc,*†
David J. Mikulis, BSc, MD,¶ Zvonimir I. Lubina, MD,|| and Michael G. Fehlings, MD, PhD, FRCSC***††

investigated factors: age, sex, duration of symptoms, JOA score, spinal column alignment, surgical technique, levels of compression, ap diameter, transverse area and MRI signal intensity

better recovery?

younger age, higher JOA

CERVICAL MYELOPATHY CLINICAL DECISION MAKING

PE: neck pain, mild ataxia,
hyperreflexia

74 yo, JOA score 11



what to do?

CERVICAL MYELOPATHY - CLASSIFICATION

Japanese Orthopaedic Association Scale

Motor dysfunction of UE: (0 – 4, 4 being none)

Motor dysfunction of LE: (0 – 4, 4 being none)

Sensory Deficit

UE (0-2, 2 being none)

LE (0-2, 2 being none)

Trunk (0-2, 2 being none)

Sphincter Dysfunction (0-3, 3 being none)

Max Total = 17

Hirabayashi K, et al: *Spine* 1981;6: 354-64

CERVICAL MYELOPATHY CLINICAL DECISION MAKING

PE: neck pain, mild ataxia,
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74 yo, JOA score 11



what to do?

CERVICAL MYELOPATHY

CLINICAL DECISION MAKING

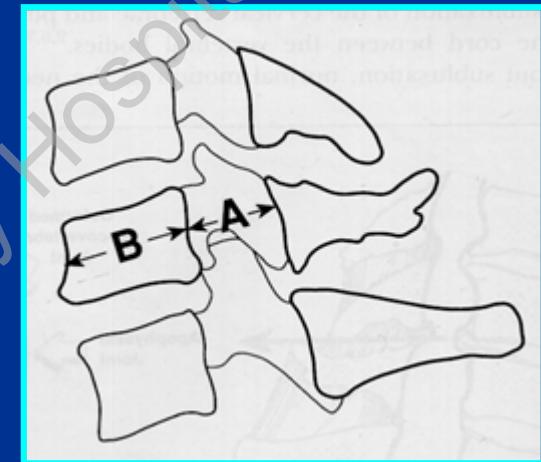
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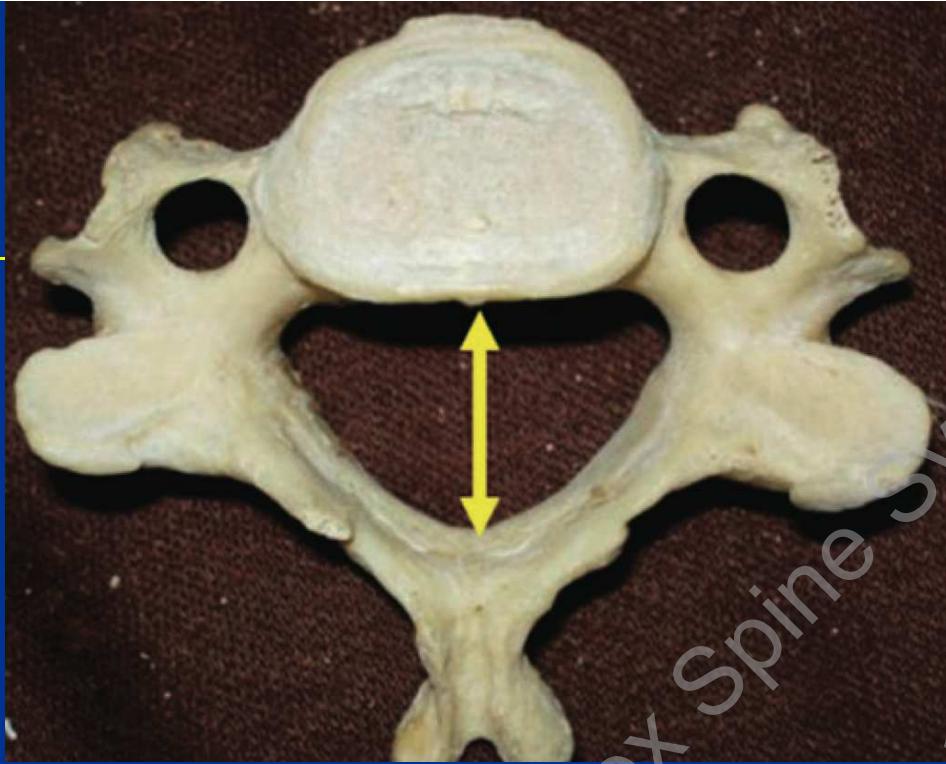
IMAGING

Plain radiographs (AP, Lat, Obliques, flex/ext)

- Disk space narrowing
- Foraminal narrowing
- Osteophytes
- Spondylolisthesis
- Dynamic instability
- Sagittal alignment
- Canal stenosis (Pavlov Ratio)
 - AP canal diam / AP vert. Body diam
 - Ratio of 1.0 is normal
 - Ratio <0.8 = developmentally narrow canal



Pavlov H et al: *Radiology* 1987; 164: 771-5



13-14mm

TABLE I Canal Diameter at Each Level According to Gender and Race

	Canal Diameter* (mm)				
	C3	C4	C5	C6	C7
All specimens (n = 469)	14.3 ± 1.6	13.9 ± 1.6	14.0 ± 1.6	14.0 ± 1.6	14.1 ± 1.4
Women (n = 204)	14.0 ± 1.5	13.5 ± 1.4	13.6 ± 1.4	13.6 ± 1.2	13.7 ± 1.2
Men (n = 265)	14.6 ± 1.7	14.2 ± 1.6	14.3 ± 1.66	14.3 ± 1.7	14.5 ± 1.5
Blacks (n = 221)	14.0 ± 1.6	13.72 ± 1.0	13.9 ± 1.51	14.0 ± 1.4	14.1 ± 1.4
Whites (n = 248)	14.6 ± 1.6	14.1 ± 1.6	14.1 ± 1.6	13.9 ± 1.7	14.2 ± 1.5
Women compared with men	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001
Blacks compare with whites	p > 0.05	p > 0.05	p > 0.05	p > 0.05	p > 0.05

Lee J et al, JBJS, 2007

IMAGING

(Myelogram)

- Degree of nerve root compression

(CT-Myelography)

- As an adjunct to/ instead of MRI
- Distinguishes disk material from osteophyte
- Better for spinal cord compression w/subluxation
- Better for evaluation of OPLL

MRI

- Gold standard
- ev. dynamic MRI (in flex/ext) for dynamic cord compression

IMAGING

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Abnormal Magnetic-Resonance Scans of the Cervical Spine in Asymptomatic Subjects

A PROSPECTIVE INVESTIGATION*†

BY SCOTT D. BODEN, M.D.‡, PHILIP R. MCCOWIN, M.D.‡, DAVID O. DAVIS, M.D.‡,
THOMAS S. DINA, M.D.‡, ALEXANDER S. MARK, M.D.‡, AND SAM WIESEL, M.D.§, WASHINGTON, D.C.

DIAGNOSIS, AS DETERMINED BY MAGNETIC RESONANCE IMAGING,
CLASSIFIED BY AGE IN SIXTY-THREE ASYMPTOMATIC SUBJECTS*

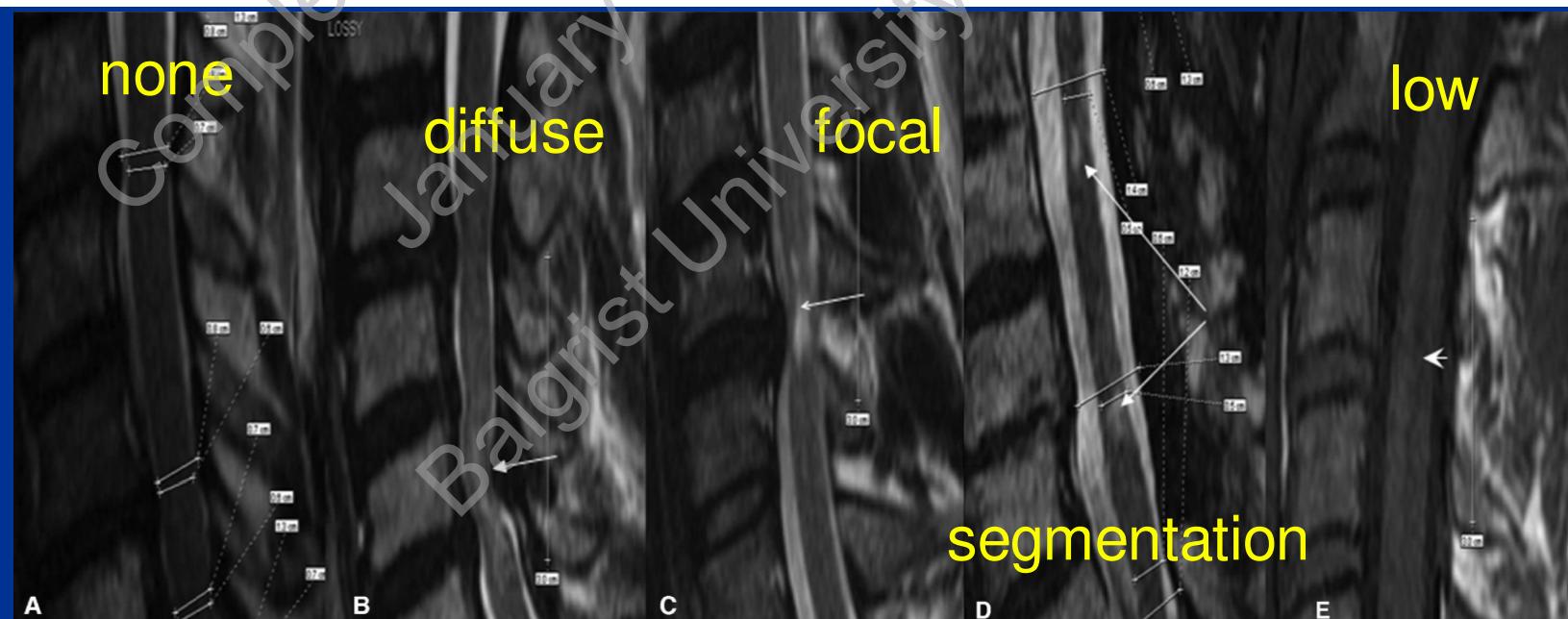
	<40 Yrs. Old (N = 40)	>40 Yrs. Old (N = 23)	Total (N = 63)
Herniated disc	4 (10%)	1 (5%)	5 (8%)
Bulging disc	0	1 (3%)	1 (2%)
Foraminal stenosis	1 (4%)	5 (20%)	6 (9%)

CERVICAL SPINE

n=57, FU 1y

Preoperative Magnetic Resonance Imaging Is Associated With Baseline Neurological Status and Can Predict Postoperative Recovery in Patients With Cervical Spondylotic Myelopathy

Babak Arvin, MD,* Sukhvinder Kalsi-Ryan, PhD,†‡§ David Mercier, MD,† Julio C. Furlan, MD, PhD,§¶||
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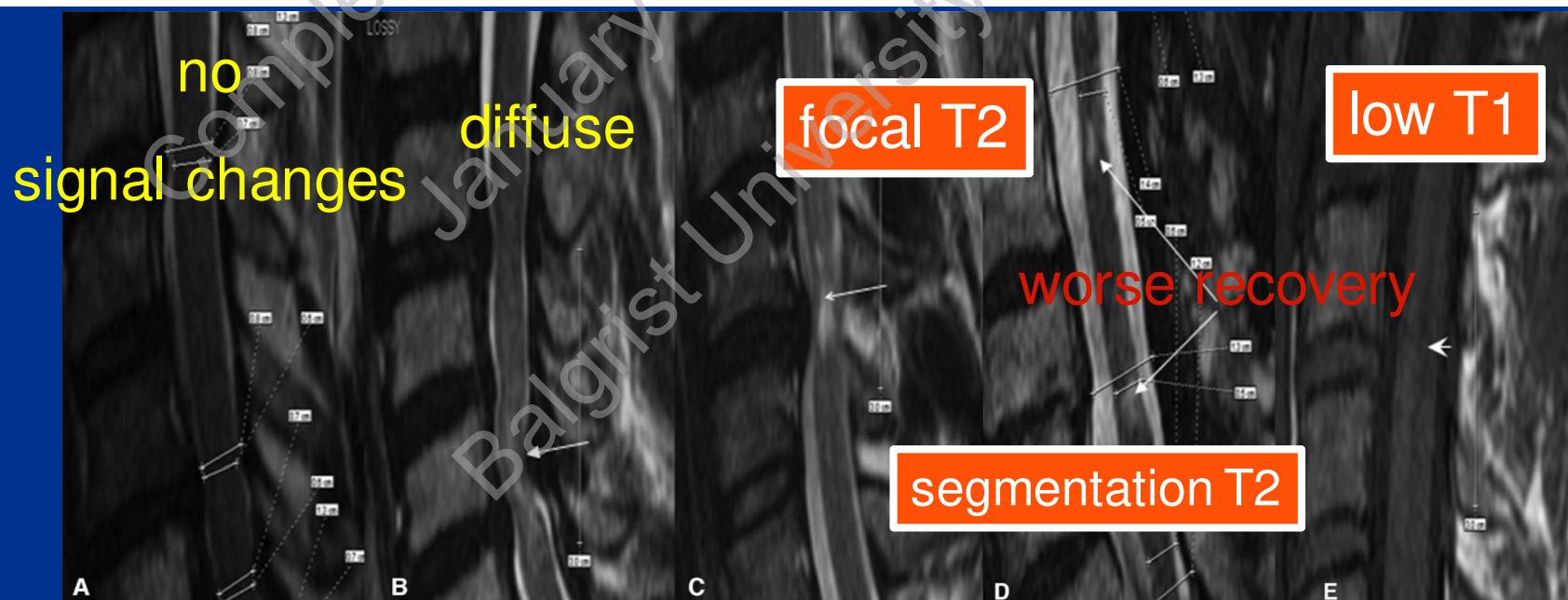


CERVICAL SPINE

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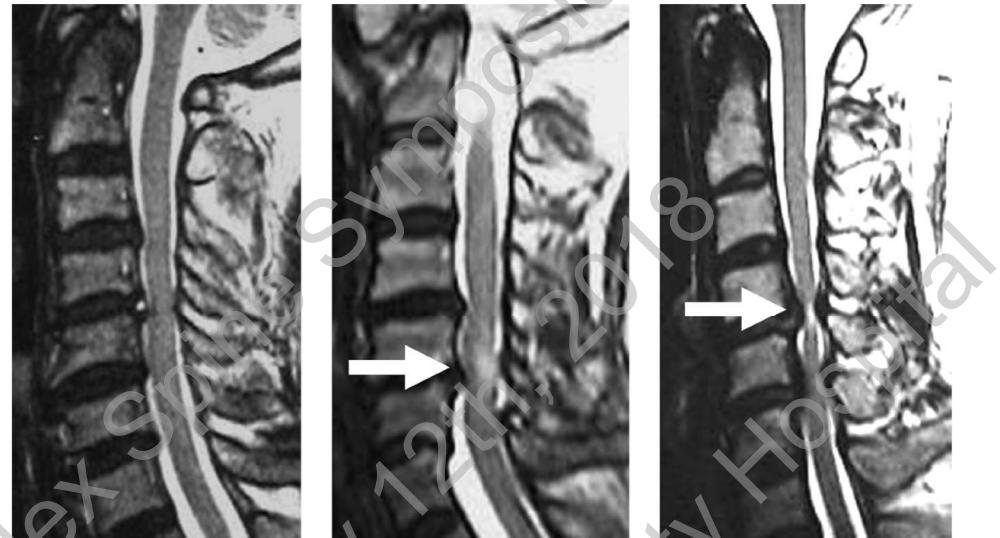
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OUTCOME AFTER SURGERY: PREDICTORS

T2WI- MRI
classification



	Grade 0	Grade 1	Grade 2	P
Age (yr)	55.3 ± 9.4	62.1 ± 10.1	62.5 ± 8.4	0.031
Duration of disease (mo)	12.1 ± 27.9	14.7 ± 21.3	32.0 ± 43.3	0.001
Preoperative JOA score	10.6 ± 2.2	9.4 ± 2.8	9.8 ± 2.8	NS
Postoperative JOA score	14.6 ± 1.9	13.3 ± 2.6	12.6 ± 2.6	0.020
Recovery rate (%)	62.3 ± 25.9	51.6 ± 25.0	36.9 ± 36.4	0.018

Yukava Y et al, Spine 32, Nr 15, pp 1675–1678

CERVICAL MYELOPATHY CLINICAL DECISION MAKING

PE: neck pain, mild ataxia,
hyperreflexia

74 yo, JOA score 11

MRI: focal signal T2-WI (g2)
and T1WI

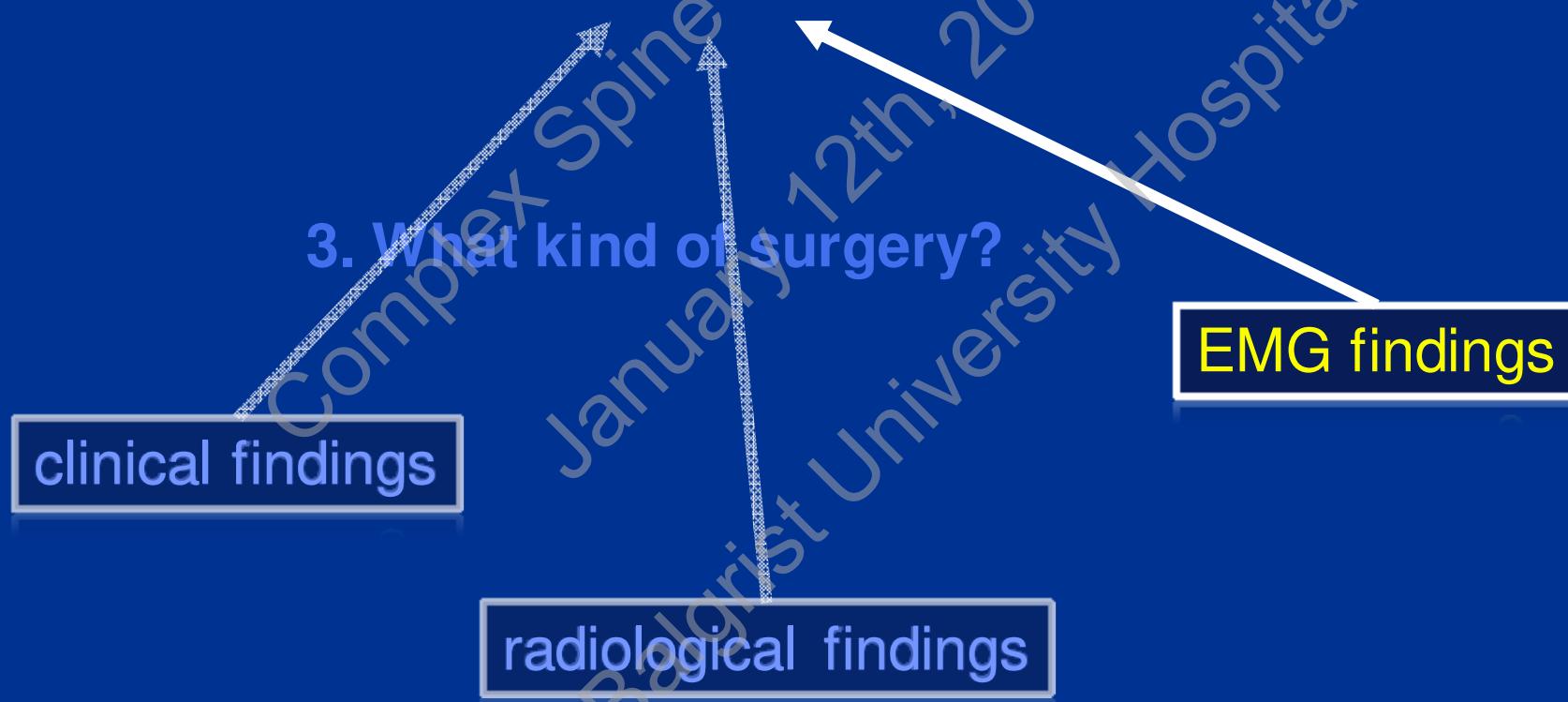


what to do?

CERVICAL MYELOPATHY

CLINICAL DECISION MAKING

1. Who needs surgery?
2. Who will do well with surgery ?



■ Presymptomatic Spondylotic Cervical Cord Compression

Josef Bednarik, MD, PhD,* Zdenek Kadanka, Prof.,* Ladislav Dusek, Doc,‡
Oldrich Novotny, MD,* Dagmar Surelova, MD,* Igor Urbanek, MD,* and
Boleslav Prokes, MD†

Predictors for development/aggravation of myelopathy?

Table 2. Initial Characteristics in Relation With the Development of Clinically Symptomatic SCM

Variable	Positivity (%)		Predictive Evaluation Based on Univariate Logistic Regression	
	SCM-Negative Cases (n = 53)	SCM-Positive Cases (n = 13)	Odds Ratio (95% confidence limits)	P Value
Sex (male)	45.3	76.9	4.02 (1.06 16.8)	0.038
Age 50 yr (category in %)	43.4	69.2	1.92 (0.68 9.0)	0.091
Clinically symptomatic radiculopathy	24.5	92.3	36.92 (4.19 325.50)	<0.001
Abnormal EMG†	11.3	61.5	12.54 (2.97 52.41)	<0.001
Abnormal SEP	9.4	38.5	6.00 (1.37 26.25)	0.016
Abnormal MEP	15.1	38.5	3.51 (0.89 13.87)	0.112
Lowered PR§	30.1	15.4	0.38 (0.07 1.99)	0.211
MR hyperintensity	32.1	46.2	1.81 (0.52 6.38)	0.347
Lowered CR	32.1	46.2	1.81 (0.52 6.38)	0.347
Lowered CSA¶	41.5	46.2	1.11 (0.35 4.19)	0.742

*Oncovision, Prague, Czech Republic. †Normal range, 0% to 100%. §Normal range, 0% to 100%. ||Normal range, 0% to 100%. ¶Normal range, 0% to 100%.

CERVICAL MYELOPATHY CLINICAL DECISION MAKING

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74 yo, JOA score 11, Nurick 2

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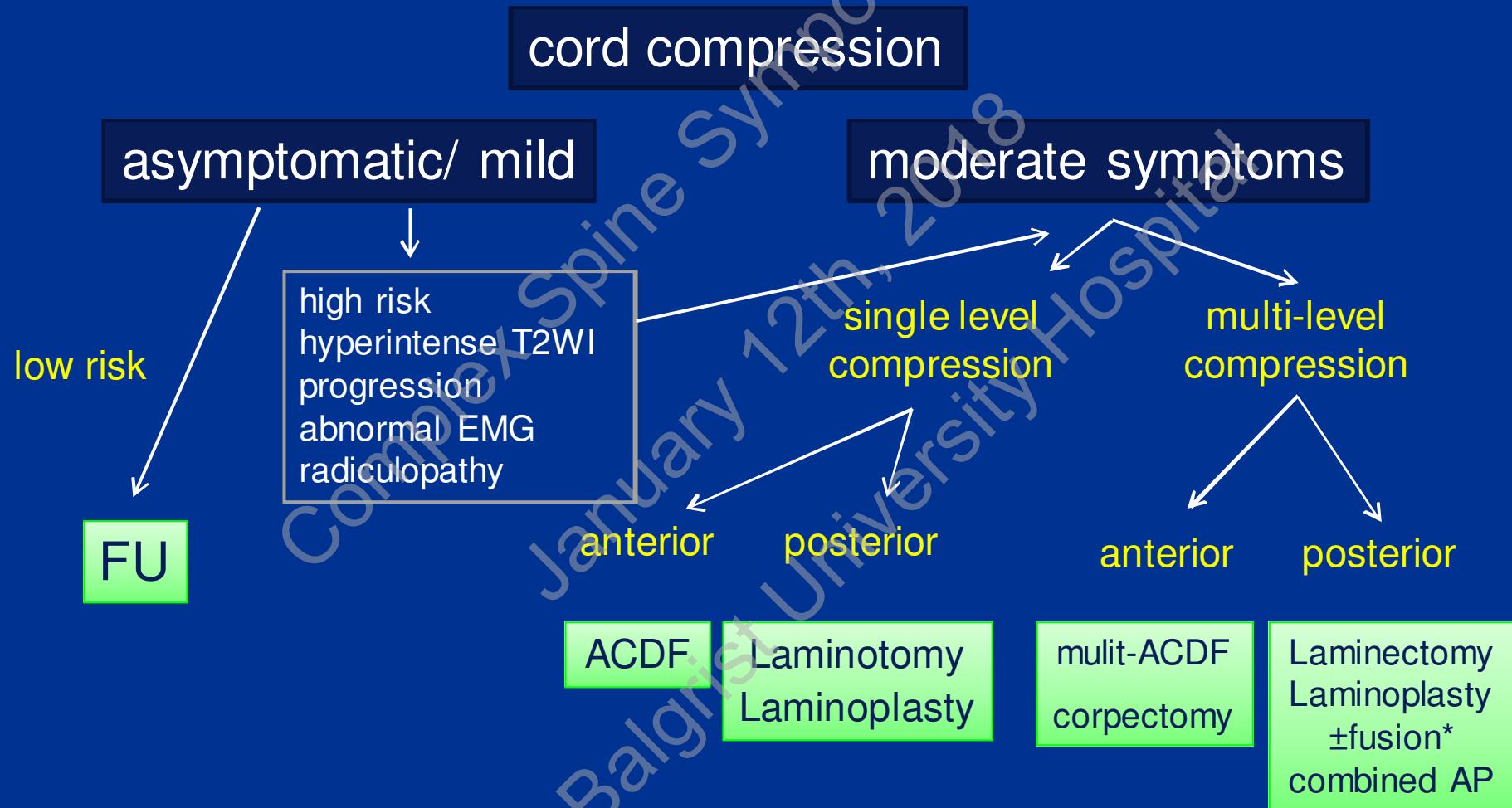
Abnormal SEP and MEP



CERVICAL MYELOPATHY CLINICAL DECISION MAKING



CERVICAL MYELOPATHY CLINICAL DECISION MAKING



* if instability or sign. kyphosis

CERVICAL MYELOPATHY

CLINICAL DECISION MAKING

- 1. Who needs surgery?**
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TREATMENT: SURGICAL

anterior vs posterior decompression



SURGICAL TREATMENT: POSTERIOR

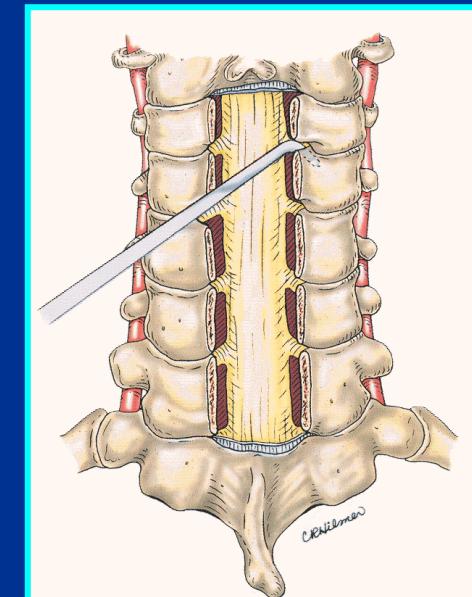
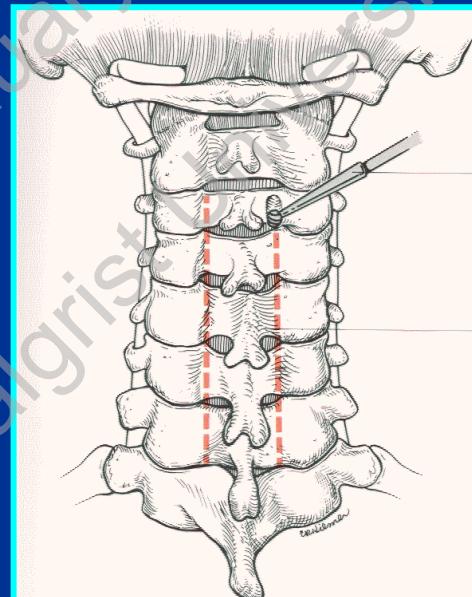
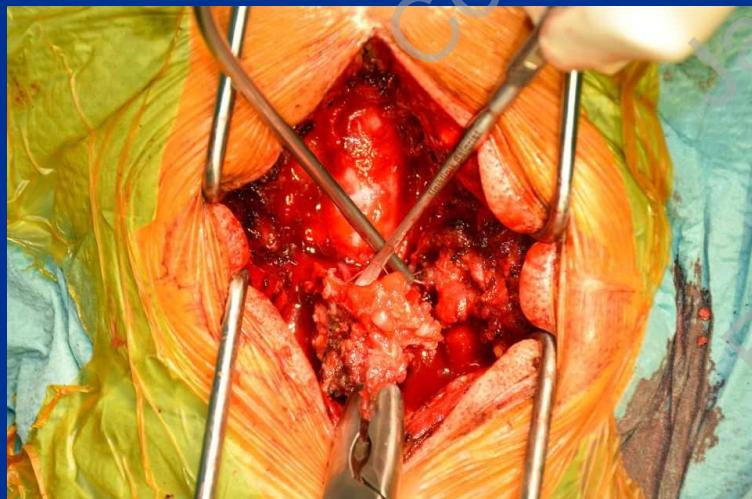
Laminectomy

– Indications

- Cervical spondylosis with canal stenosis in a lordotic cervical spine
- “stable segments”

– Problems:

- Post-laminectomy kyphosis on long-term follow up
- Transitory C5 palsy



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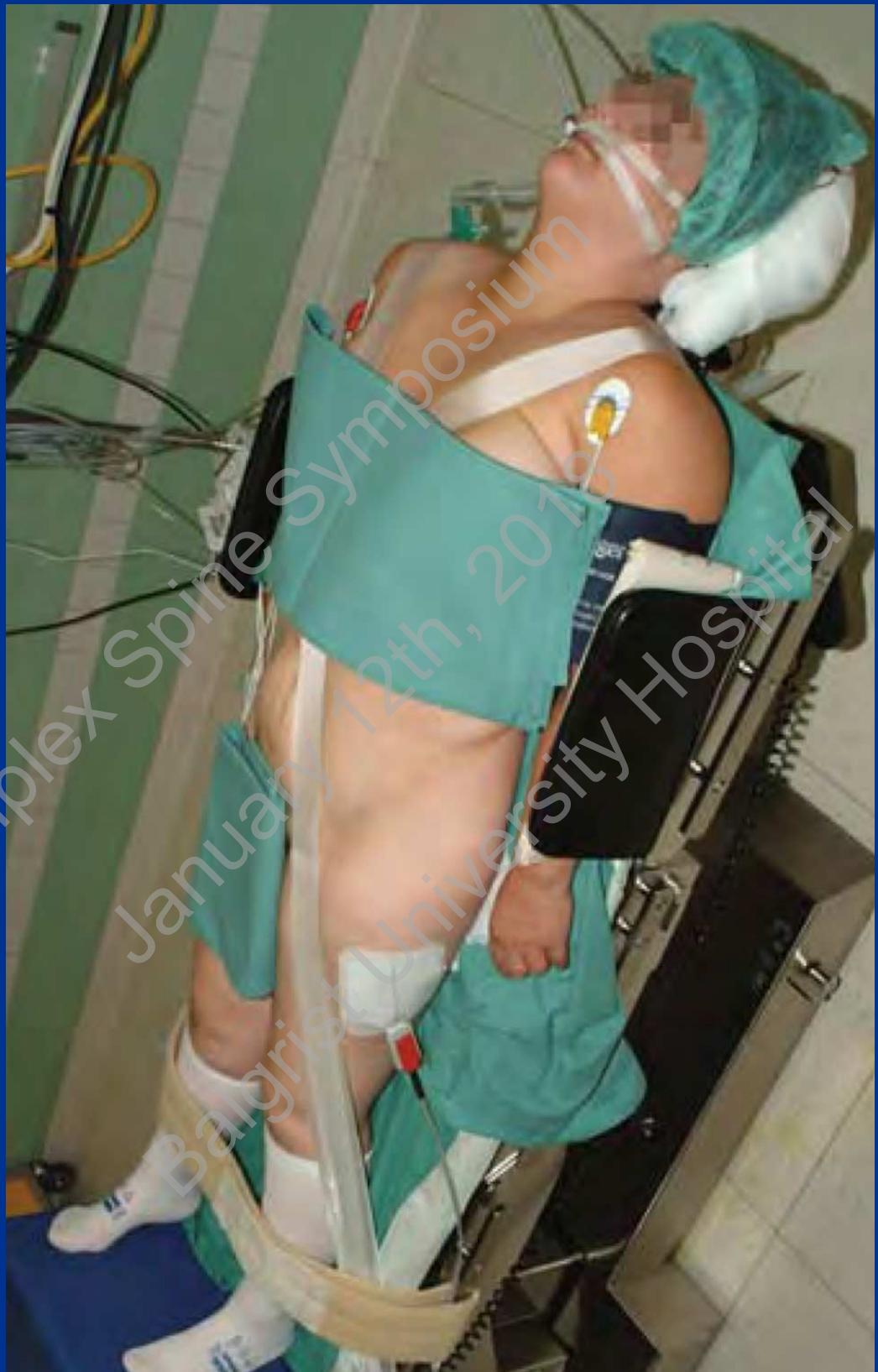
SURGICAL TREATMENT: POSTERIOR

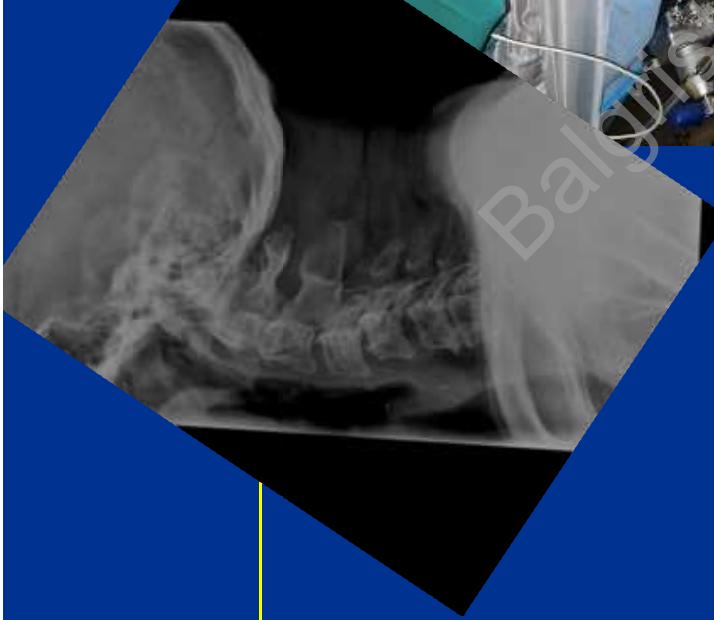
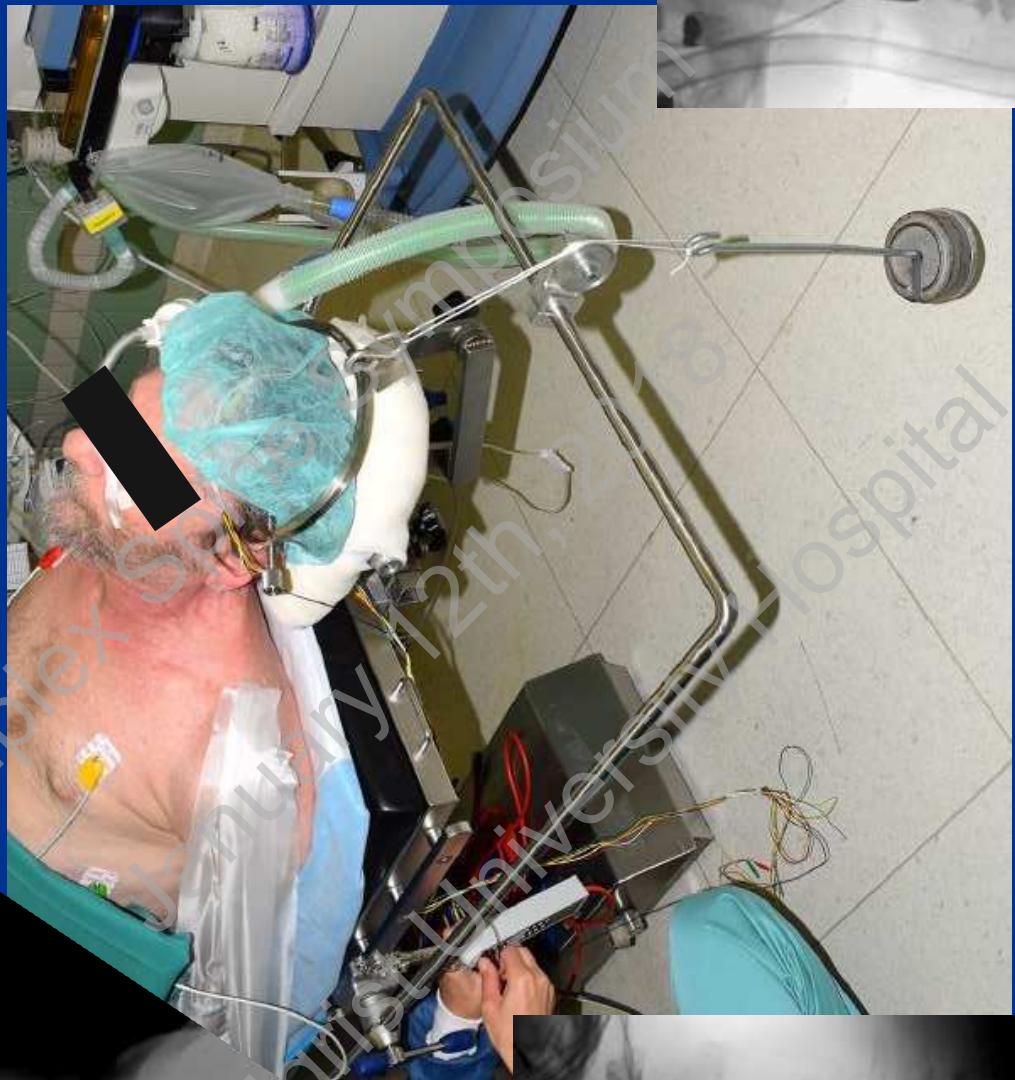
Laminoplasty

- Indications
 - Symptomatic cervical canal stenosis with a lordotic cervical spine
 - Canal stenosis 2° to OPLL
- Relies on indirect decompression of cord
- **PROBLEM:** more axial neck pain

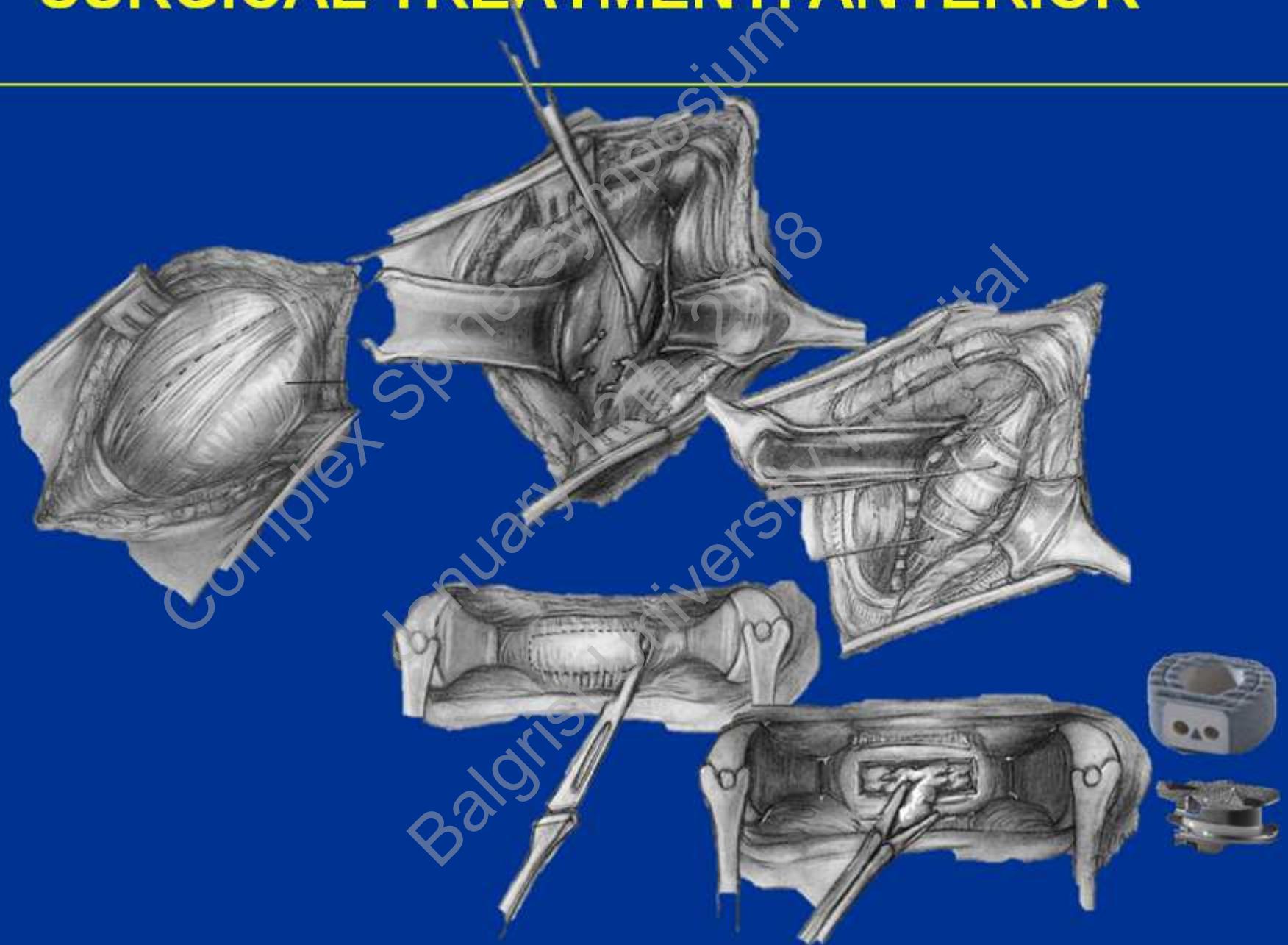


Complex Spine Symposium
January 7th, 2018





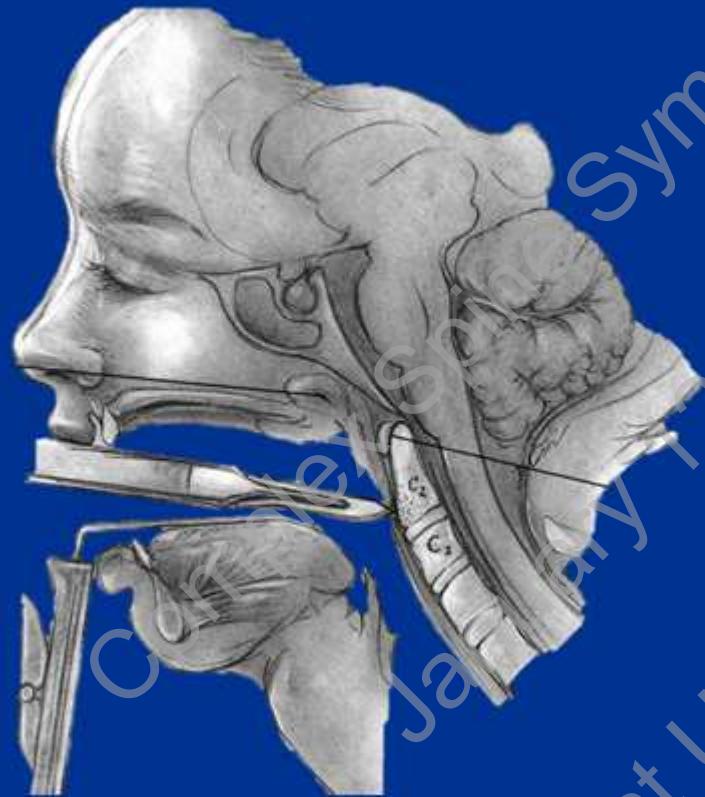
SURGICAL TREATMENT: ANTERIOR



SURGICAL TREATMENT: CORPECTOMY



SURGICAL TREATMENT: TRANSORAL



approach to C1/2 from anterior

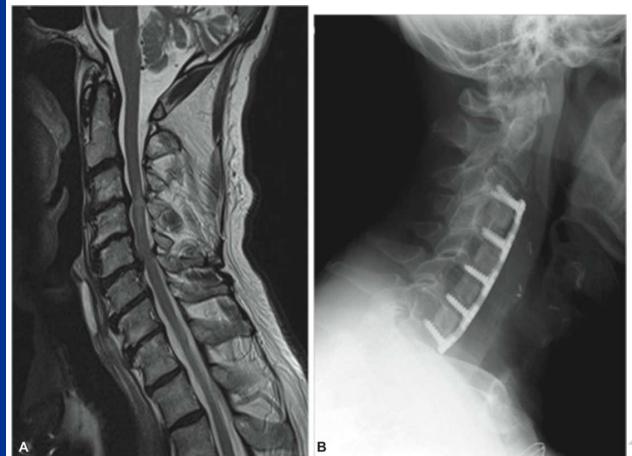


CERVICAL SPINE

Anterior Versus Posterior Surgical Approaches to Treat Cervical Spondylotic Myelopathy

Outcomes of the Prospective Multicenter AO Spine North America CSM Study in 264 Patients

Michael G. Fehlings, MD, PhD,* Sean Barry, MD,* Branko Kopjar, MD,† Sangwook Tim Yoon, MD,‡
Paul Arnold, MD,§ Eric M. Massicotte, MD,* Alexander Vaccaro, MD, PhD,¶ Darrel S. Brodke, MD,||
Christopher Shaffrey, MD,** Justin S. Smith, MD, ** Eric Woodard, MD, †† Robert J. Banco, MD, #‡
Jens Chapman, MD,† Michael Janssen, DO,§§ Christopher Bono, MD, ¶¶ Rick Sasso, MD, ||||
Mark Dekutoski, MD,*** and Ziya L. Gokaslan, MD †††



... “The results from this large, prospective multicenter study support the idea of **relative equivalence between anterior and posterior** surgery for CSM that many spine surgeons think exists. “ ...

CERVICAL MYELOPATHY CLINICAL DECISION MAKING

PE: neck pain, mild ataxia,
hyperreflexia **since 6 months**

74 yo, JOA score 11, Nurick 2

MRI: focal signal T2-WI (g2)
and T1WI

Abnormal SEP and MEP

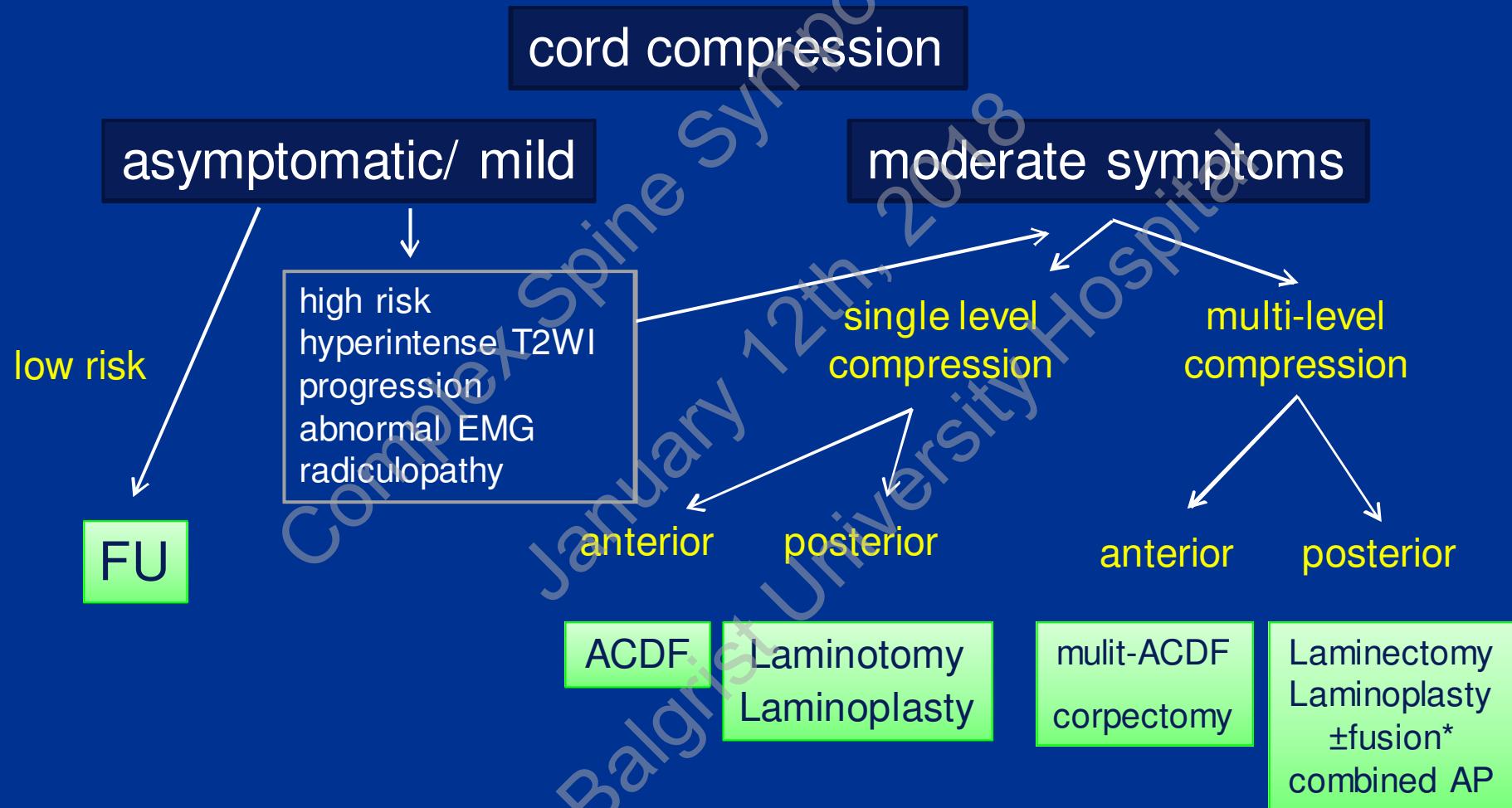
major comorbidities

segmental instability



what to do?

CERVICAL MYELOPATHY CLINICAL DECISION MAKING



* if instability or sign. kyphosis

SURGICAL TREATMENT of CSM: ...MANY CONTROVERSIES

- Anterior surgery for 1 - 2 levels and posterior procedures for 3 or more levels?
- Plating for anterior surgery to increase union rate for 3 level ACDF, how about 2 levels?
- Disc prosthesis versus cage?
- Multi-level corpectomies should be instrumented with posterior segmental instrumentation as opposed to anterior plates alone?
- Post-Laminectomy kyphosis- predictors?

CERVICAL MYELOPATHY

CLINICAL DECISION MAKING

PE: neck pain, mild ataxia,
hyperreflexia since 6 months

74 yo, JOA score 11, Nurick 2

MRI: focal signal T2-WI (g2)
and T1WI

Abnormal SEP and MEP

major comorbidities

segmental instability



what to do?

A systematic review of clinical and surgical predictors of complications following surgery for degenerative cervical myelopathy

Lindsay Tetreault, BSc,¹ Ahmed Ibrahim, MD, FRCS, PhD,¹ Pierre Côté DC, PhD,²
Anoushka Singh, PhD,¹ and Michael G. Fehlings, MD, PhD, FRCSC¹

summary of 36 prognostic cohort studies and 28 comparative intervention studies

- BMI, smoking, duration of symptoms, and baseline severity score
- blood loss, surgical approach, and number of levels
- A longer operative duration, 2-staged procedure
are ass. with major complications

J Neurosurg Spine September 25, 2015

COMPLICATIONS IN CERVICAL SPINE SURGERY

- **Pseudarthrosis**
 - up to 12% for single level fusions, 30% for multilevel fusions
- **Postoperative c5 palsy**
 - ~ 5% of patients after surgery for cervical myelopathy
- **Recurrent laryngeal nerve injury**
- **Hardware failure and migration**
- **Post-laminectomy kyphosis**
- **Vertebral artery injury**
- **Esophageal injury**

COMPLICATIONS IN COMPLEX CERVICAL SPINE SURGERY

- Death (up to 2.6%)
- Transitional shear to myelon resulting in quadriplegia (case reports)
- Oseophagal rupture during osteocleisis (case reports)
- CVI (case reports)
- Postop Neuropraxia (18-30%)
- Transient dysphagia (38%)
- Persisting neurological deficit (4.3%)
- C5 neuropraxia (Laminectomy effect) (5%)

Etame et al, Spine, 2008 Jul 15;33(16):E559-64.

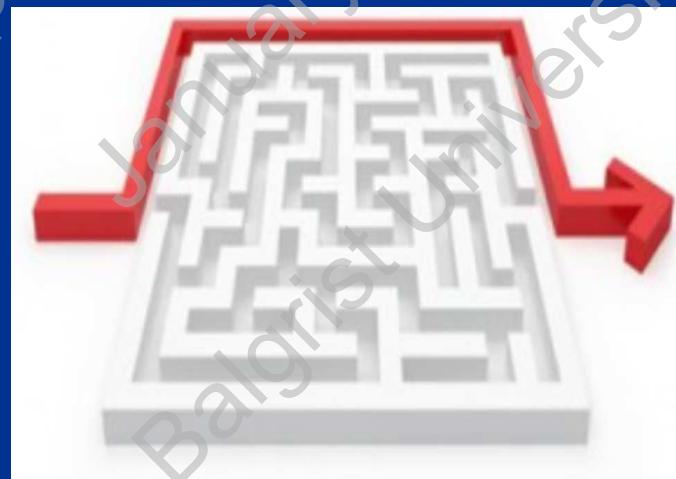
Hoh et al, Neurosurg Focus. 2008;24(1):E9.

Belanger et al, J Bone Joint Surg Am. 2005 Aug;87(8):1732-8.

SURGICAL COMPLICATIONS

how to avoid surgical complication in complex cervical spine surgery?

→turn complex into less complex surgery



CERVICAL MYELOPATHY CLINICAL DECISION MAKING

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ACDF

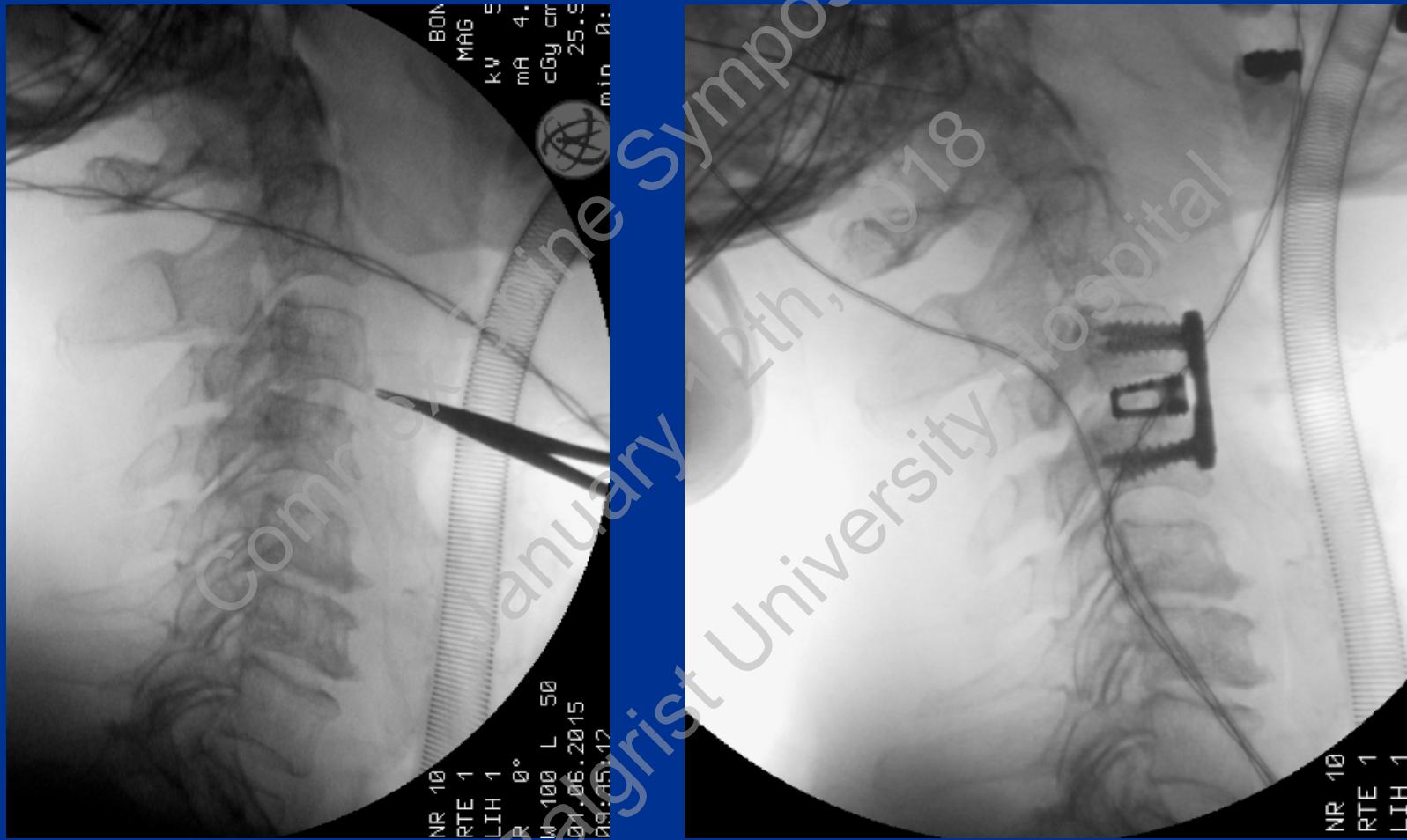


what to do?

CERVICAL MYELOPATHY CLINICAL DECISION MAKING



CERVICAL MYELOPATHY CLINICAL DECISION MAKING



 Everything should be made
Complex, as simple as possible,

Balgrist University Hospital
January 12th, 2018
Spine Symposium



Complex spine Symposium
January 12th, 2018

Albert Einstein

Everything should be made
as simple as possible,
but not simpler.

Complex Spine Symposium
January 12th, 2018

NECKS.



Spine
Complex Posture

'program, Friday, January 12, 2018

Myelopathy			
8:00	Commercial Exhibit in the Lobby		
8:30	Introduction: Degenerative cervical myelopathy	M. Farshad	
8:50	Anterior approaches and surgical techniques in treatment of myelopathy	M.G. Fehlings	
9:10	Posterior approach in treatment of myelopathy caused by CSM or OPLL	K. Abumi	13.40 MRI of the cervical spine - What a Spine Surgeon should know
9:30	Advanced assessments in cervical myelopathy	A. Curt	C. Pfirrmann
9:50	<i>Coffee Break</i>		
10.30	Upper Cervical Spine Trauma	C. Josten	14.00 Case presentation 1
10.50	Lower Cervical Spine Trauma	H. Pape	14.15 Case presentation 2
11.10	Complex Cervical Trauma treatment	M.G. Fehlings	14.30 Case presentation 3
			14.45 Case presentation 4
			15.00 Case presentation 5
			15.15 Q&A
			All
			15.45 <i>End of Symposium</i>
			L. Regli K. Abumi
			<i>are Complexities</i>
11.30	Intradural cervical tumors		
11.50	Cervical and cervicothoracic deformities		
12.10	<i>Lunch</i>		