Cervical Spine Surgery:
Approach related outcome
Hez Progect
Israel 2016

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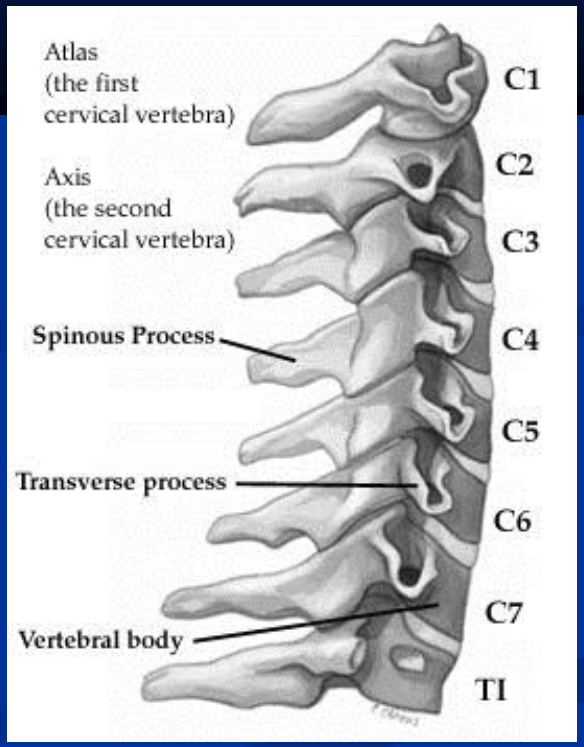
Subaxial Cervical Spine

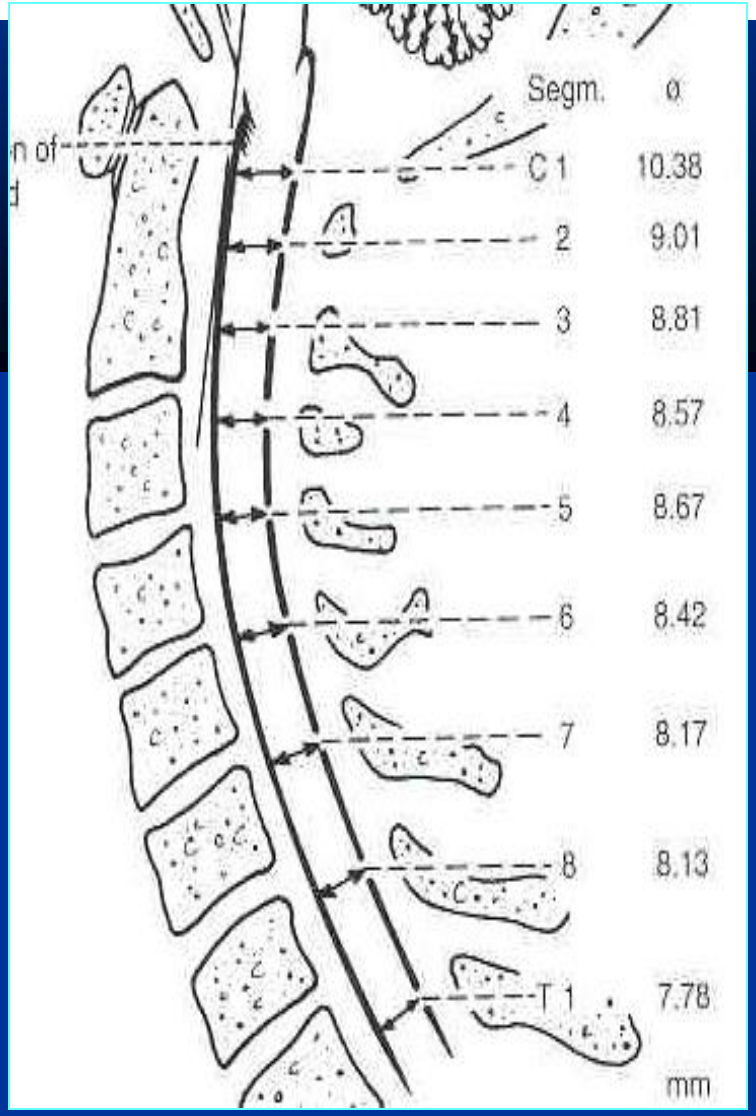
- Biomechanically different from upper CS
- 50% cervical flexion/extension/rotation
- 45 degree coronal orientation of facets
  - **Allows for significant motion**



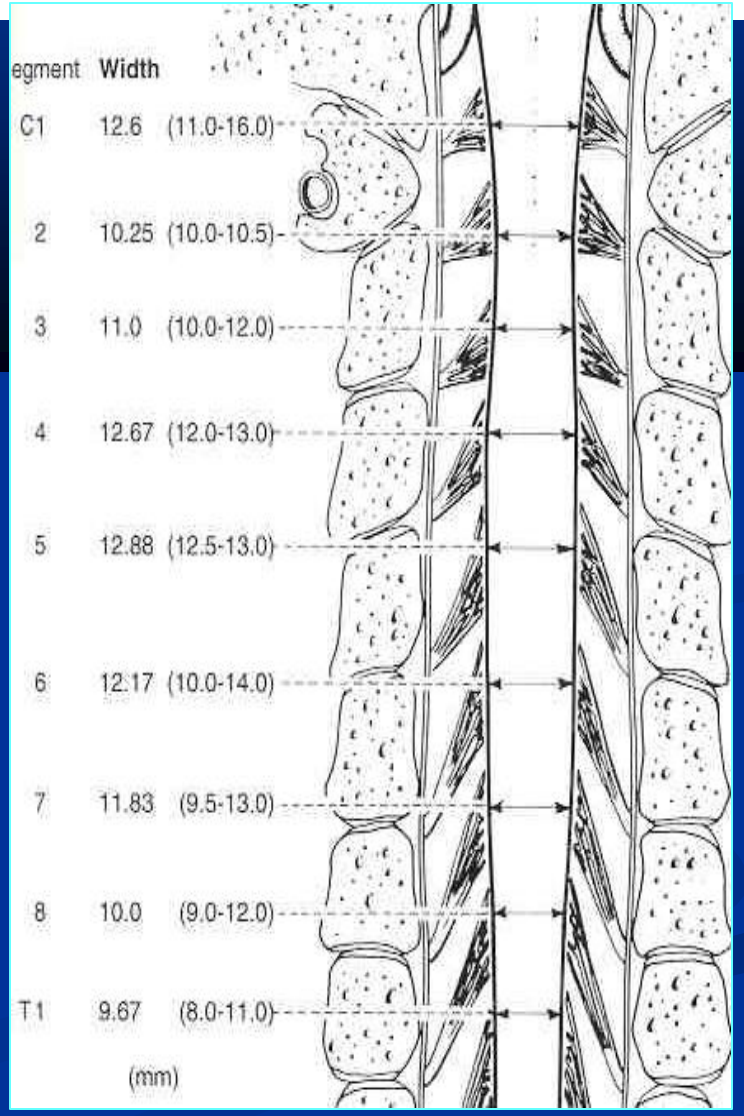
Midsagital Canal Diameter

$C_0 - C_1$	23 mm
$C_1 - C_2$	20 mm
$C_3 - C_6$	17-18 mm
$C_6 - C_7$	15 mm
$C_7 - T_1$	15 mm

Spinal cord diameter



Midsagittal



Midcoronal

Subaxial pathologies

Myelopathy

- any disease or disorder of the spinal cord or bone marrow

Radiculopathy

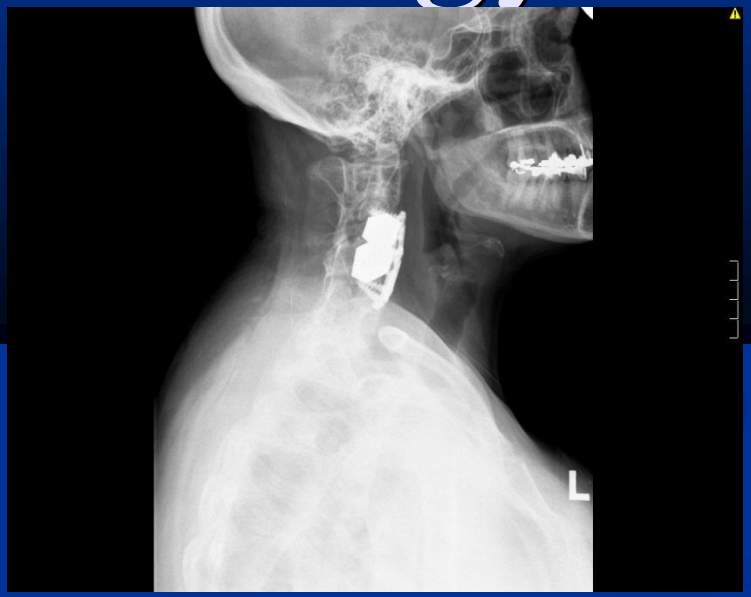
- any pathologic condition at the nerve roots

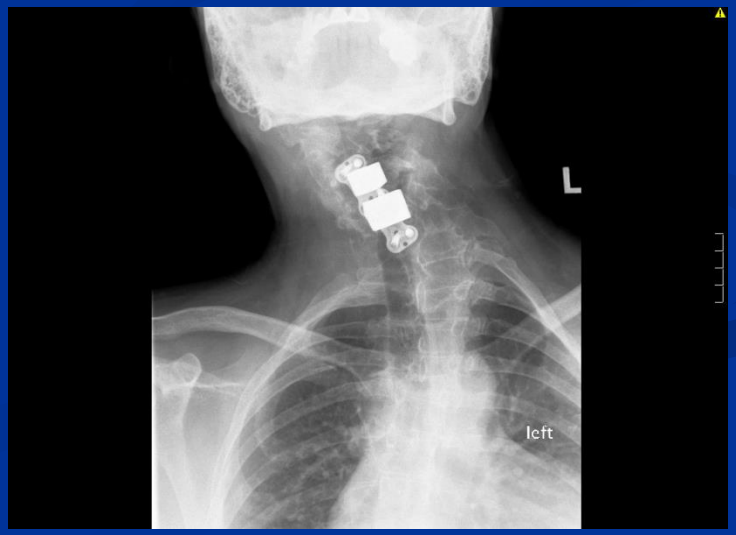
Neck pain

Cervical pathology

Multiple etiologies

- Degenerative (spondylosis)
- Trauma
- Vascular
- Rheumatologic
- Congenital
- Neoplastic
- Idiopathic
- Iatrogenic



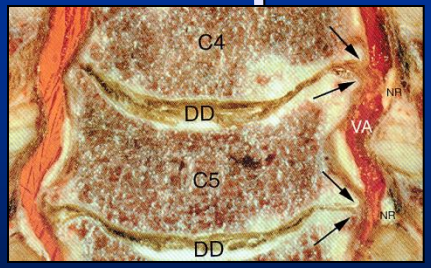


Cervical Spondylosis

- **Natural event with aging……..**
- Wear & tear of discs, facet joints and vertebrae

- By 65 yrs, 95% men and 70% women have radiographic degeneration
  - Gore DR et al. Spine 1986
- Most changes are asymptomatic
- C3-7 most common segments
  - **C5-6 > C6-7 >** C4-5 > C3-4

Pathophysiology of Cervical Spondylosis



Disc desiccation / narrowing

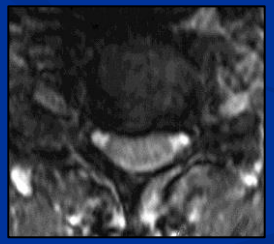
Disc bulging

Marginal / reactive osteophyte formation

Ligament hypertrophy, buckling

Spinal deformity (kyphosis, olisthesis)

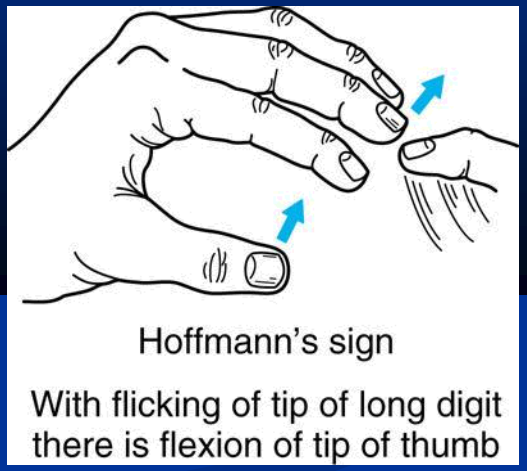
VARIABLE PROGRESSION



Cervical Spondylosis: Myelopathy

Myelopathy

- weakness (upper > lower)
- decreased manual dexterity
- ataxic, broad-based shuffling gait
- sensory changes
- spasticity
- urinary retention



Hoffmann's sign

With flicking of tip of long digit there is flexion of tip of thumb

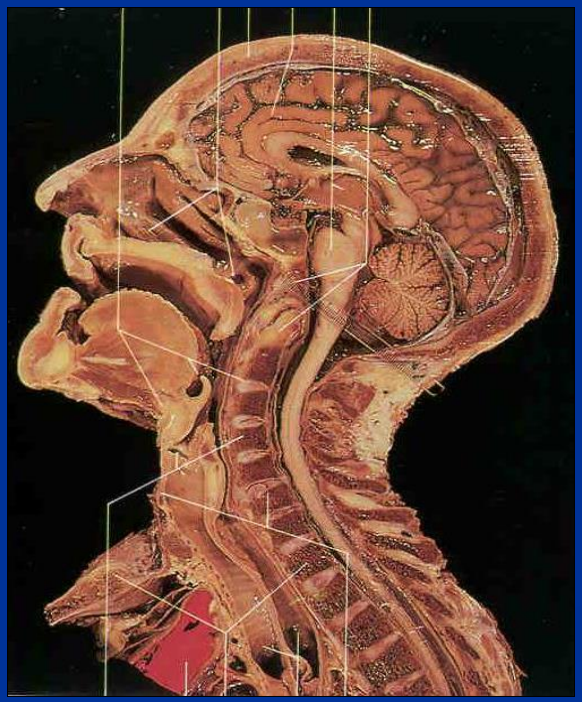
Most worrisome complaint: Lower extremity weakness (corticospinal tracts)

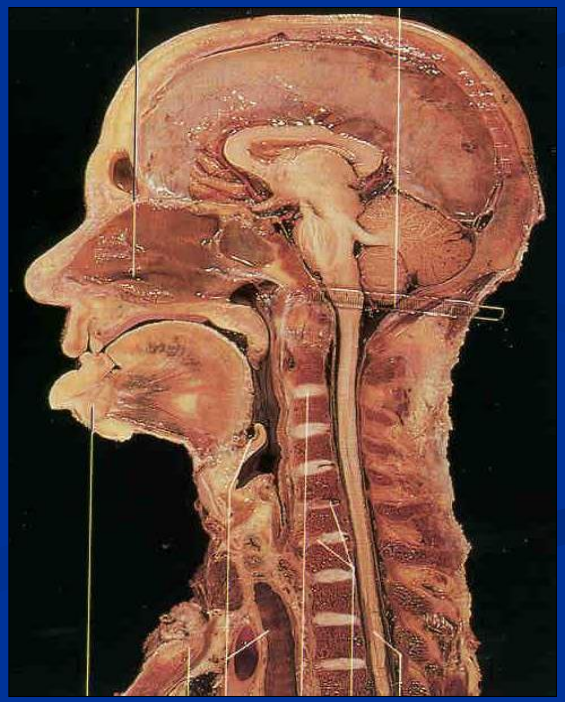
Miller, MD. Review of Orthopaedics, 3rd Edition, 2000.

Dynamic Factors

- Cord diameter enlarges in extension related to shortening of the cord's length and subsequent enlargement of its cross-sectional area
- 8-11mm cord change with flexion and extension
- Shear forces on neuronal fiber tracts

Henderson FC. Neurosurgery 56(5), 2005





Natural History

Clark and Robinson (Brain, 1956)

- Followed 120 patients
- Complete remission to normality does not occur
- Spontaneous regression of neurologic deficits is uncommon

– 75% episodic neurologic worsening

– 20% slow steady progression

– 5% rapid deterioration

Outcome of patients treated for cervical myelopathy. A prospective, multicenter study with independent clinical review.

Sempath et al, Spine. 2000 Mar 15;25(6):670-6

CSRS Study: Prospective, non-randomized

- 43 patients with CSM
  - 20 SURGERY
  - 23 NON-SURGICAL

Results:

Surgically treated pts had better…

- Functional status
- Pain relief
- Neurologic status

Outcome of patients treated for cervical myelopathy. A prospective, multicenter study with independent clinical review.

Sempath et al, Spine. 2000 Mar 15;25(6):670-6

Conclusions:

- "When medical and surgical treatments are compared, **surgically treated patients appear to have better outcomes**, despite exhibiting a greater number of neurologic and non-neurologic symptoms and having greater functional disability before treatment. "

Functional and clinical outcomes following surgical treatment in patients with cervical spondylotic myelopathy: a prospective study of 81 cases.

J Neurosurg Spine. 2011. Furlan JC, Kalsi-Ryan S, Kailaya-Vasan A, Massicotte EM, Fehlings MG.

81pts underwent surgery

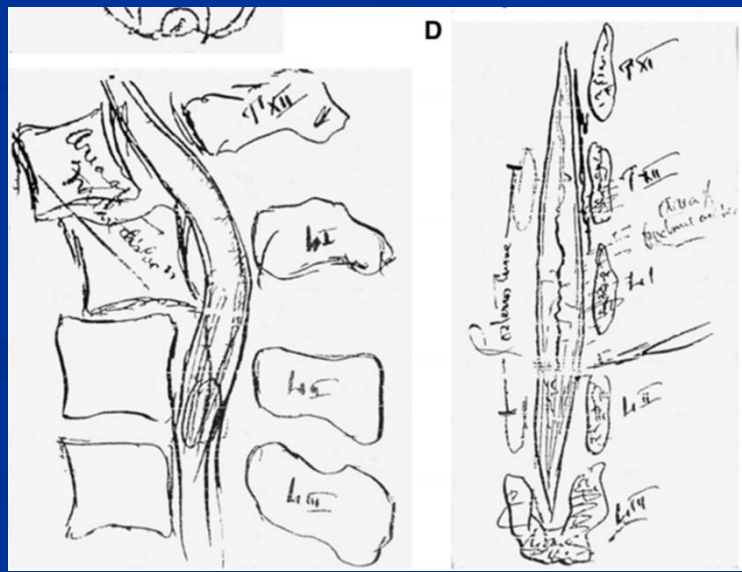
surgery for CSM is associated with significant functional recovery

older age ($p < 0.002$) and greater number of ICD-9 codes ($p < 0.01$) were significantly associated with poorer functional recovery

Background

Posterior cervical approach and laminectomy has been described over a hundred years ago

The addition of instrumentation allowing for fusion has been added in recent decades

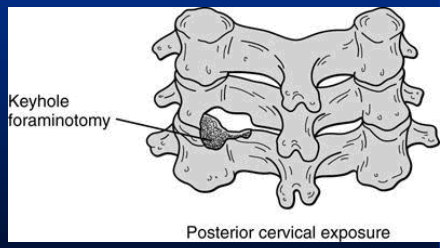


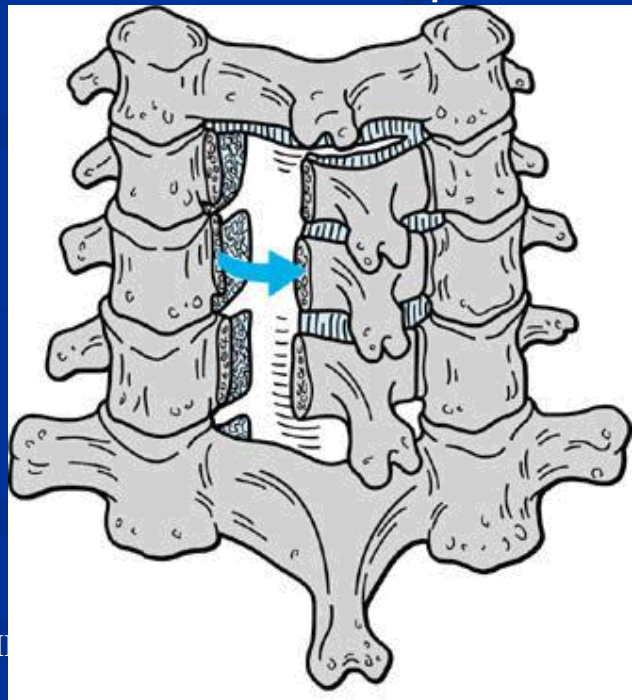
Cervical Spondylosis: Treatment

Posterior approaches

- Laminoplasty
  - Commonly used for OPLL
  - Decreases incidence of instability associated w/ multilevel laminectomy

Overall alignment must be lordotic for this technique to be successful





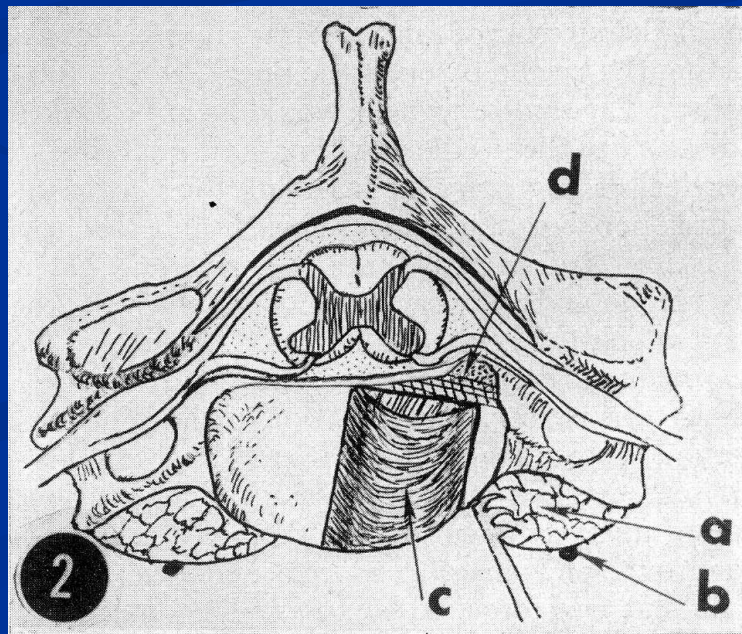
Opening door laminoplasty

Miller, M

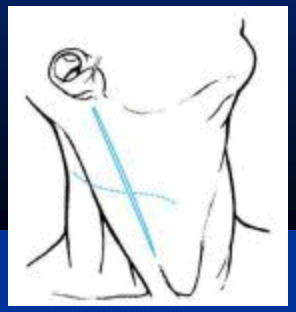
Anterior Approach

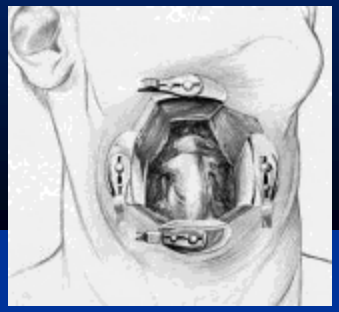
Anterior cervical approach was first described on 1958 (Cloward; Smith and Robinson)

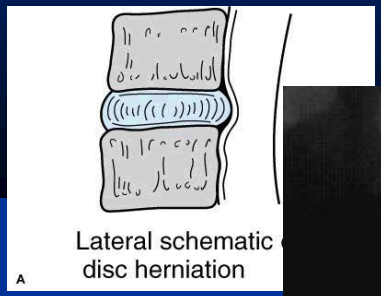
This approach was heavily criticized

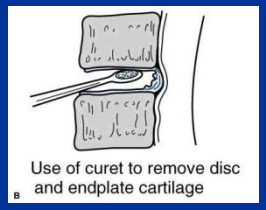


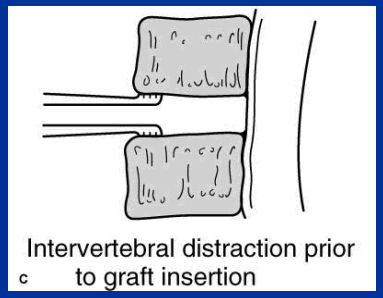
Cervical Spondylosis: Treatment

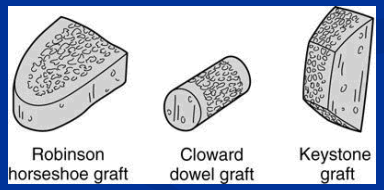












Miller, MD. Review of Orthopaedics, 3rd Edition, 2000.

Eur Spine J (2009) 18:1951–1956
DOI 10.1007/s00586-009-1110-x

ORIGINAL ARTICLE

Comparison of ventral corpectomy and plate-screw-instrumented fusion with dorsal laminectomy and rod-screw-instrumented fusion for treatment of at least two vertebral-level spondylotic cervical myelopathy

Rudolf Andreas Kristof · Thomas Kiefer · Marcus Thudium ·

Ant Vs. Post

- Hypothesis: posterior approach is better
- Retrospective cohort, 42 Ant Vs. 61Post
- Most outcomes were equivalent, anterior app. patients had better postoperative Nurick scores

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Comparative Effectiveness of Ventral vs Dorsal Surgery for Cervical Spondylotic Myelopathy

BACKGROUND: Cervical spondylotic myelopathy (CSM) is the most common cause of spinal cord dysfunction.

OBJECTIVE: To determine the feasibility of a randomized clinical trial comparing the clinical effectiveness and costs of ventral vs dorsal decompression with fusion surgery for treating CSM.

METHODS: A nonrandomized, prospective, clinical pilot trial was conducted. Patients ages 40 to 85 years with degenerative CSM were enrolled at 7 sites over 2 years (2007-2009). Outcome assessments were obtained preoperatively and at 3 months, 6 months, and 1 year postoperatively. A hospital-based economic analysis used costs derived from hospital charges and Medicare cost-to-charge ratios.

RESULTS: The pilot study enrolled 50 patients. Twenty-eight were treated with ventral fusion surgery and 22 with dorsal fusion surgery. The average age was 61.6 years. Baseline demographics and health-related quality of life (HR-QOL) scores were comparable be-

- Non randomized prospective pilot examine the best surgical strategy
- 28 Ventral Vs. 22 Dorsal
- Ventral group: more neurological improvement, similar complications rate, less hospital expanses and shorter length of stay

Spine

SPINE Volume 38, Number 26, pp 2247-2252

CERVICAL SPINE

Anterior *Versus* Posterior Surgical Approaches to Treat Cervical Spondylotic Myelopathy

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

Michael G. Fehlings, MD, PhD,* Sean Barry, MD,* Branko Kopjar, MD,† Sangwook Tim Yoon, MD,‡

- Multicenter prospective study including 278 myelopathic patients treated in 12 centers by either anterior (169) or posterior (95) approach
- Anterior approach patients were younger and less myelopathic
- Both approaches have equivalent efficacy in neurological improvement scales when patient and disease factors are controlled for.

Eur Spine J (2015) 24:1621–1630
DOI 10.1007/s00586-015-3911-4

CrossMark

ORIGINAL ARTICLE

Comparison of anterior approach versus posterior approach for the treatment of multilevel cervical spondylotic myelopathy

Jiaquan Luo[1] · Kai Cao[2] · Sheng Huang[1] · Liangping Li[1] · Ting Yu[1] · Cong Cao[1] · Rui Zhong[1] · Ming Gong[1] · Zhiyu Zhou[1] · Xuenong Zou[1]

- Meta-analysis including 10 non-randomized trials comparing the anterior and posterior approach
- No significant neurologic recovery advantage to either approach
- Anterior approach harbored higher complication rates

Spine
SPINE Volume 40, Number 13, pp 1033-1038

HEALTH SERVICES RESEARCH

Anterior *Versus* Posterior Approach for Multilevel Degenerative Cervical Disease

A Retrospective Propensity Score-Matched Study of the MarketScan Database

Tyler Cole, BS, Anand Veeravagu, MD, Michael Zhang, BA, Tej D. Azad, BA, Atman Desai, MD, and John K. Ratliff, MD, FACS

- Retrospective; national longitudinal database
- 2006 -2010: 13,662 patients; spondylotic myelopathy
  - Operated for 3 or more levels
- Anterior cervical approach was associated with significantly lower rates of complication (excluding dysphagia), re-operation rates, re-admission rates, shorter hospital stays, lower hospital payments and lower total payments

ORIGINAL ARTICLE

Cervical Spine Surgery: Approach-Related Complications

Ran Harel[1,2], *Petros Stylianou*[3], *Nachshon Knoller*[1]

OBJECTIVE: Cervical spine surgery is a common procedure for treatment of wide variety of pathologies. In this paper we report approach-related complication rates experienced by our patients.

METHODS: We retrospectively evaluated data from patients who were treated surgically for cervical pathologies from February 2011 to October 2013. Medical records were collected and evaluated. We compared the anterior cervical approach with the posterior cervical approach for patients operated for all cervical pathologies, and a subanalysis was performed for patients with cervical myelopathy.

RESULTS: The study included 251 patients (192 anterior vs. 59 posterior). The anterior approach patients were younger (not significant), but the indications for surgery varied significantly. Mean number of levels treated was 2.2 approach was associated with significantly lower rates of complication especially infection related complications.

INTRODUCTION

The posterior cervical approach for decompression of the spine has been described as early as the first years of the last century.[1] In recent decades, the addition of lateral mass screws facilitated the fusion of the cervical spine through the posterior approach.[2] The anterior cervical approach was first described on 1958 by Cloward[3] and by Smith and Robinson[4] and was heavily criticized by spine surgeons. This approach gained popularity as a result of improved instrumentation and better technique over the last decades, but the debate for best surgical solution is ongoing.

Kristof et al.[5] favored the dorsal approach for multilevel spondylotic myelopathy; however, their retrospective cohort

Methods

Retrospective cohort

February 2011 to October 2013

Department of Neurosurgery; Sheba Medical Center

All pathologies included

Results

	Anterior Approach	Posterior Approach	p value
Number	192	59	
Age	53.1	57.7	0.07
Gender (males %)	65.6%	72.8%	0.24
smoking %	32.3%	20.3%	0.06
Diabitis Melitus (%)	16.6%	16.9%	0.57
IHD (%)	8.8%	13.5%	0.23
HTN (%)	29.1%	30.5%	0.59
Diagnosis			
Cervical Myelopathy	131 (68%)	34 (58%)	P<0.0005*
Trauma	29 (15%)	6 (10%)	
Radiculopathy	16 (8%)	2 (3%)	
Deformity	5 (2.6%)	4 (7%)	
Infection	6 (3%)	0 (0%)	
Tumor	4 (2%)	5 (8.5%)	
Instability	1 (0.5%)	8 (13.6%)	

IHD- Ischemic Heart Disease; HTN- Hypertension

		Anterior Approach	Posterior Approach	P value
Number of levels		2.2	3.5	<0.0005*
Level range		C2-D2	Occiput-D2	
Length of stay (days)		5.4	6.4	0.34
Discharge destination	Home Rehabilitation Hospital dept. Mortality	148 (77%) 42 (22%) 1 (0.5%) 1 (0.5%)	40 (68%) 19 (32%) 0 (0%) 0 (0%)	0.37
Post-operative hematoma		0 (0%)	1 (2%)	0.06
Dural tear		14 (11.5%)	4 (6.8%)	0.06
CSF leak		2 (1%)	3 (5%)	0.041
Deep vein thrombosis		1 (0.5%)	0 (0%)	0.45
Pulmunary embolism		1 (0.5%)	0 (0%)	0.45
Total infections		10 (5.8%)	9 (11.9%)	0.008*
Respiratory infections		8 (4.2%)	0 (0%)	0.09
UTI		0 (0%)	0 (0%)	-
superficial wound infection		1 (0.5%)	2 (3.4%)	0.06
deep wound infection		1 (0.5%)	5 (8.5%)	<0.0005*
Instrumentation suboptimal position		1 (0.5%)	2 (3.4%)	0.06
Pseudoarthrosis		1 (0.5%)	3 (5 %)	0.01*

		Anterior Approach	Posterior Approach	P value
Post-operative Neurologic status	Improvement	112 (58.5%)	32 (54%)	0.39
	Stable	70 (36.5%)	21 (36%)	
	deterioration	10 (5%)	6 (10%)	
Post-operative respiratory complication	Prolonged intubation	7 (3.6%)	0 (0%)	0.11
	Dyspnea treated with steroids	1 (0.5%)	0 (0%)	0.45
Revision of surgery		4 (2%)	9 (15%)	<0.0005*
Mortality		2 (1%)	1 (2%)	0.52
Total complications number		44	32	<0.0005*
Total patients experiencing complications		15 (7.8%)	12 (20.3%)	0.005*
Length of follow-up (months)		4.9	5.6	0.44

Myelopathy Only

	Anterior Approach	Posterior Approach	p value
Number	131	33	
Age	56	66	<0.005*
Gender (males %)	66.4%	84.8%	0.03*
smoking %	35.8%	24.2%	0.2
Diabitis Melitus (%)	19.0%	18.1%	0.2
IHD (%)	9.1%	18.1%	0.14
HTN (%)	33.5%	42.4%	0.34

		Anterior Approach	Posterior Approach	P value
Number of levels		3.4	4.1	<0.0005*
Level range		C2-D2	Occiput-D1	
Length of stay (days)		4.7	5.8	0.24
Discharge destination	Home Rehabilitation Hospital dept. Mortality	106 (81%) 25 (19%) 0 (0%) 0 (0%)	24 (73%) 9 (27%) 0 (0%) 0 (0%)	0.3
Post-operative hematoma		0 (0%)	1 (3%)	0.04*
Dural tear		9 (6.9%)	1 (3%)	0.4
CSF leak		1 (0.7%)	1 (3%)	0.2
Deep vein thrombosis		1 (0.7%)	0 (0%)	0.61
Pulmunary embolism		1 (0.7%)	0 (0%)	0.61
Total infections		2 (1.5%)	4 (12%)	<0.005*
Respiratory infections		2 (1.5%)	0 (0%)	0.47
UTI		0 (0%)	0 (0%)	-
superficial wound infection		0 (0%)	0 (0%)	-
deep wound infection		0 (0%)	4 (12%)	<0.0005*
Instrumentation suboptimal position		1 (0.5%)	0 (0%)	0.61
Pseudoarthrosis		0 (0%)	1 (3 %)	0.045*

		Anterior Approach	Posterior Approach	P value
Post-operative Neurologic status	Improvement	79 (60.3%)	19 (57.5%)	0.37
	Stable	45 (34.3%)	10 (30.3%)	
	deterioration	7 (5.3%)	4 (12.1%)	
Post-operative respiratory complication	Prolonged intubation	1 (0.7%)	0 (0%)	0.61
	Dyspnea treated with steroids	1 (0.7%)	0 (0%)	0.61
Revision of surgery		2 (1.5%)	4 (12%)	<0.005*
Mortality		0 (0%)	0 (0%)	-
Total complications number		19	14	<0.0005*
Total patients experiencing complications		8 (6.1%)	6 (18.1%)	0.026*
Length of follow-up (months)		4.7	5.6	0.42

Limitations

Retrospective cohort

Selection bias:

- Posterior approach: Older patients, more levels
- Both senior surgeons favor the anterior approach

Conclusion

Cervical surgery is effective and safe procedure.

The ventral approach is associated with lower complication rates, especially lower wound infections rates

Maya's Project

Addition of the 2014-2016 patients

Project question:

- Anterior or Posterior?
- High cervical and high thoracic anterior approach outcomes
- Corpectomy Vs. discectomy outcomes
- Rate of lordosis loss in cervical kyphosis correction surgery