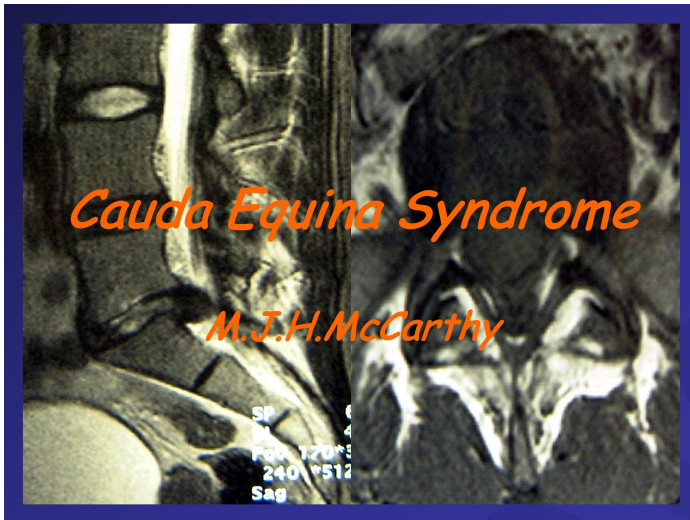


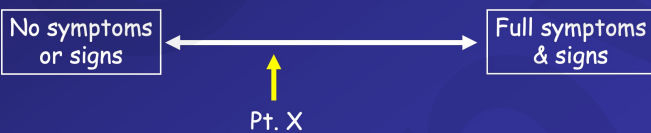


What is cauda equina syndrome?

- A spectrum of low back pain, uni / bilateral sciatica, saddle anaesthesia and motor weakness in the lower extremities with variable rectal and urinary symptoms

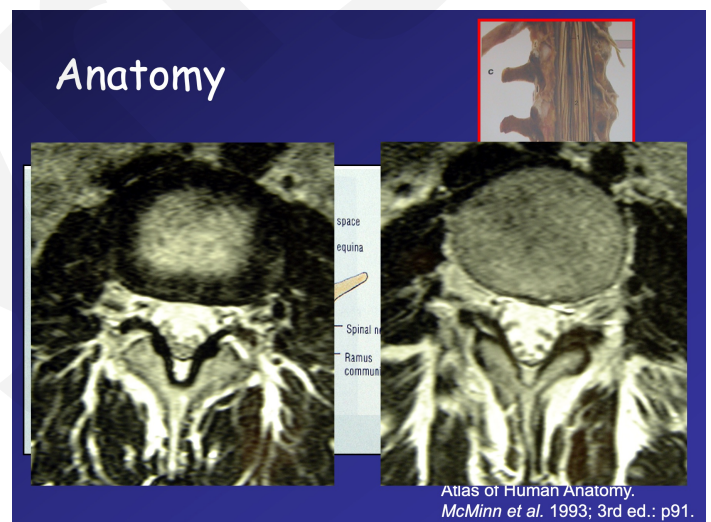
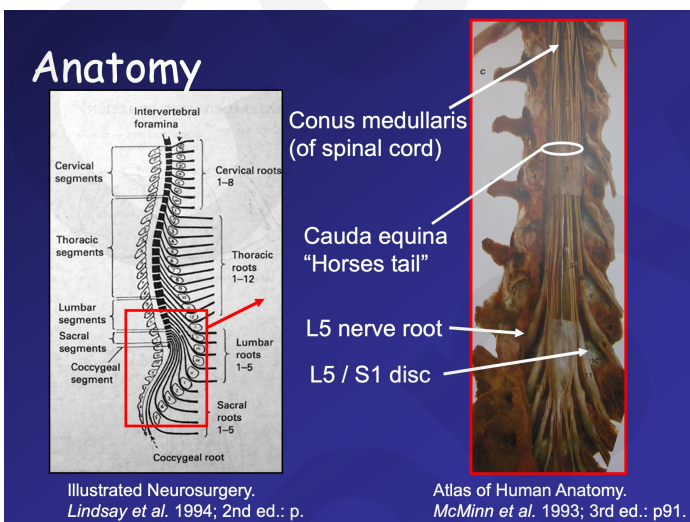
Presentation - shades of gray...

- Spectrum
- Dynamic
 - developing
 - snap-shot



Anatomy

- **Cauda Equina** = "Horses Tail"
 - Comprises the Spinal Roots after the end of Spinal Cord
 - Spans from below the conus medullaris to the filum terminale
 - Lies in subarachnoid space L2-C0
- **Conus Medullaris** = "conical" and "inner region of an organ"
 - End of spinal cord - approx. level L1 in Adults
 - S3-C0 roots originate here

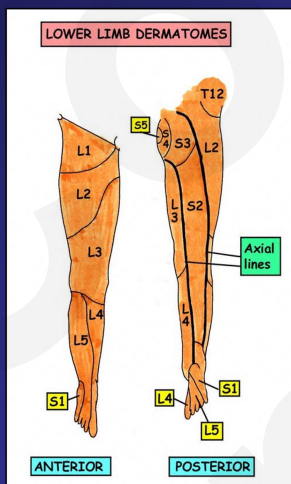


Physiology

Fiber	Function (examples)	Diameter (μm)	Conduction velocity (m/s)
A α	Afferents - muscle spindle, tendon organ. Efferents - skeletal muscle	15	70-120
A β	Afferents - touch	8	30- 70
A γ	Efferents - muscle spindle	5	15- 30
A δ	Afferents - temperature, fast pain	3	12- 30
B	Sympathetic, preganglionic	3	3- 15
C	Sympathetic, postganglionic afferents - slow pain	1 (unmyelinated)	0.5- 2

Segmental Myotomes

Hip	Flexion	L2	Iliopsoas	Femoral
	Extension	L4-5	Glut Max	Inf. Glut.
Knee	Flexion	L5-S1	Hamstrings	Sciatic
	Extension	L3	Quads	Femoral
Ankle	Dorsiflexion	L4	Tib Ant	Deep Peroneal
	Plantarflexion	S1	Gastroc	Tibial



Pathology

- Classification of Cauda Equina Compression:
- Extra-dural
- Intra-dural extra-medullary
- Intra-dural intra-medullary

Causes

- Disc prolapse
 - ~2% of operated prolapses
- Other
 - spondylosis - stenosis
 - tumour
 - trauma
 - post-surgical - haematoma
 - infection



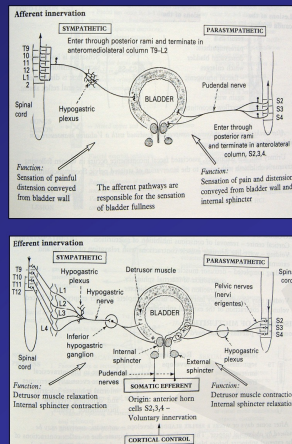
Motor/Sensory Nerve Function

- Weakness
- Shooting Pains - Radiculopathy
- Parasthesia
- Numbness

Bladder Function

• Bladder

- Retention of urine
 - "can't start stream"
- Incontinence
 - "can't feel stream"



Bowel & Sexual Function

• Bowel

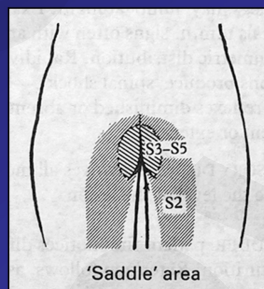
- flaccid external sphincter
- faecal retention with impaction

• Sexual

- loss of genital sensation
- loss of reflex erections and ejaculation
- ♂ infertility
- ♀ fertile

Clinical Presentation - Symptoms

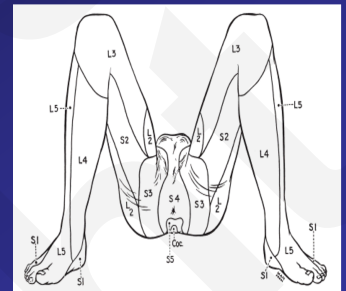
- LBP
- Root Compression
 - Motor / sensory
 - Uni- / Bilateral
- Sphincter Disturbance
 - "saddle" numbness
 - Urinary incontinence / retention
 - Faecal incontinence



Illustrated Neurosurgery.
Lindsay et al. 1994; 2nd ed.: p.

Clinical Presentation - Signs

- Motor
 - Foot drop
 - Anal Tone
 - Urinary Retention
- Sensory
 - L4-S1
 - "Saddle" numbness
- (Reflexes)
- (SLR)



Illustrated Neurosurgery.
Lindsay et al. 1994; 2nd ed.: p.

Differential Diagnosis

- Acute Radiculopathy
 - NO OBJECTIVE SPHINCTER DISTURBANCE
 - DO A RECTAL EXAM →
 - "Patient has no anus or surgeon has no fingers"
 - "If you don't put your finger in it you put your foot in it"
- Conus Lesions
- Neuropathy
 - Diabetes



Equipment

- PR
 - KY-jelly
 - wipes
 - Neurotip



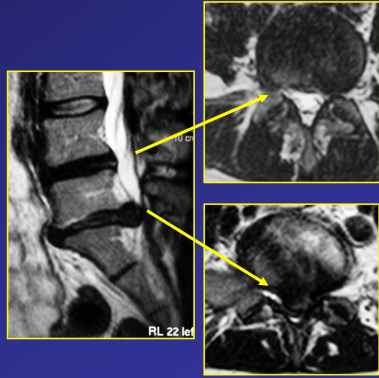
• Urological

- catheter residual
- urodynamics
 - stopwatch

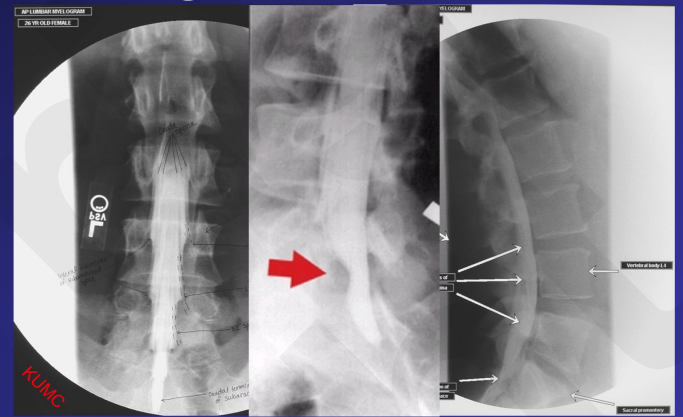
100mls+

Investigations

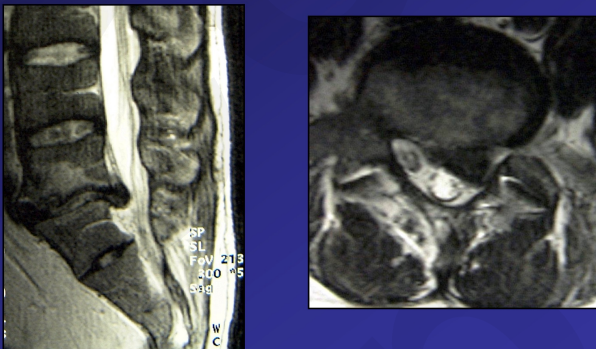
- MRI
 - Whole spine
- Other
 - Bloods
 - Remember Coag
 - X-ray
 - Levels
 - CT myelogram



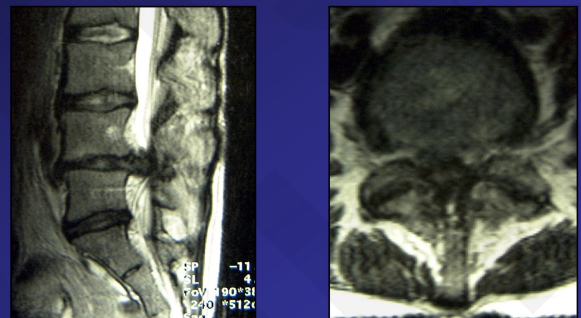
Investigations



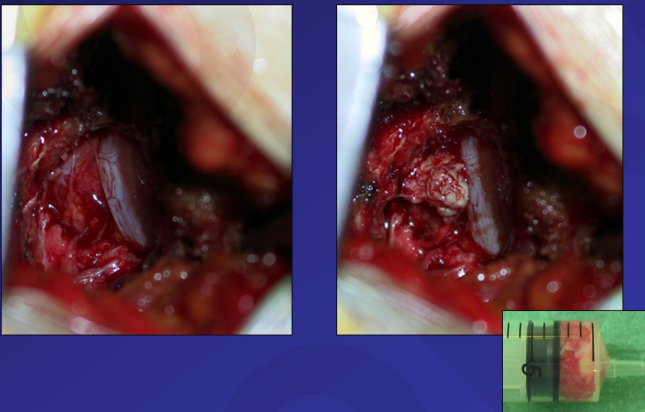
Left L5/S1 Disc Prolapse



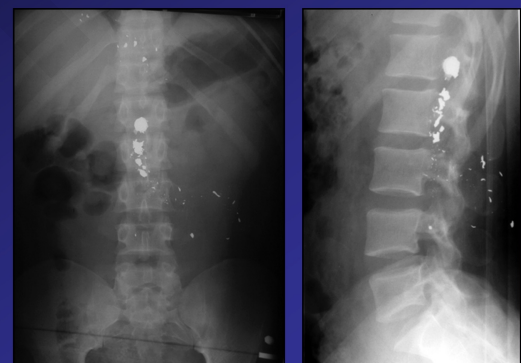
Central L4/5 Disc Prolapse



Operation



One you're unlikely to see



One you're unlikely to see



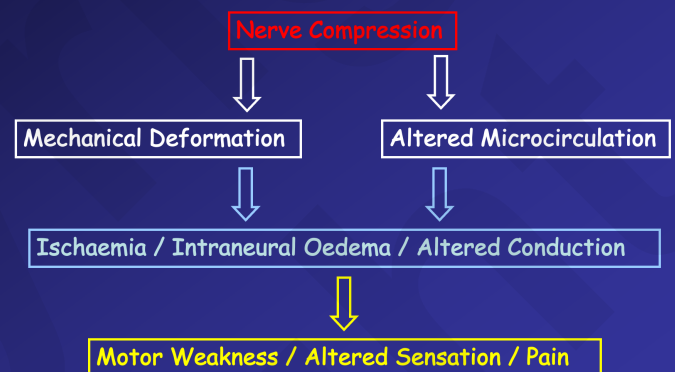
Pathophysiology and Outcome of CES

Neuropathology

- **Neurapraxia**
 - Compression
 - Local conduction block and demyelination
- **Axonotmesis**
 - Traction / Severe Compression
 - Wallerian degeneration
 - Recovery poor
- **Neurotmesis**
 - Severed
 - Requires repair - worst recovery

Seddon 1943

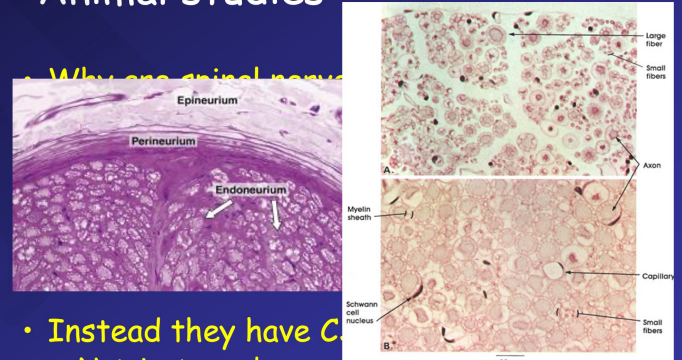
Animal studies



Animal studies

- Gelfan and Tarlov 1956 Am J Physiol
- Sharpless 1975 NINCDS
- Electrophysiology of compressed spinal and peripheral nerves in cats
- Spinal nerves more susceptible to compression

Animal studies



- Instead they have C
 - Nutrient supply
 - Mechanical protection

Animal studies

- Olmarker et al. 1989 J Ortho Res
 - Pig Model
 - More rapid onset of compression
 - More pronounced the neurological deficit
- Sayegh et al. 1997 JBJS
 - Rat Model
 - Longer duration of compression
 - Longer the recovery (but all recovered)
- Rydevik et al. 1991 Spine
 - Pig Model
 - Graded compression in mmHg
 - >75mmHg EMG reduced and recovery slowed
 - 75 < 100 < 200mmHg

Animal studies

Constriction of Cauda Equina	25%	50%	75%
Motor Weakness	No	Yes - grad recovered	Yes - 4/6 persisted @
Incontinence	No	No	Yes - 4/6 urine 2/6 faeces
Cystometry	Normal	Normal	Abnormal
CEPs	Normal	Reduced	Marked Reduction
Histology	Occ. enlarged axons	Axonal atrophy + dystrophy	Sig. axonal atrophy + dystrophy

Bodner et al. J Urol 1990; vol.143: pgs.186-90.

Greater Compression = Worse Outcome

Animal studies

- Delamarter et al. 1991 Volvo Award
 - 30 Dogs, 5 groups of 6
 - 75% compression of Cauda Equina
 - Decompression - immediate, 1 hour, 6 hours, 24 hours and 1 week
 - Motor/bladder function, SSEPs, Histology
 - Increased delay in recovery with increased time to decompression
 - But...

Spine 1991; vol.16: pgs.1022-9.

Animal studies

At 6 Weeks:

No significant differences between the groups

Histology suggests:

The damage is done at the time of compression

Spine 1991; vol.16: pgs.1022-9.

Cauda Equina Syndrome Secondary to Lumbar Disc Herniation

A Meta-Analysis of Surgical Outcomes

Uri Michael Ahn, MD,* Nicholas U. Ahn, MD,* Jacob M. Buchowski, MS,* Elizabeth S. Garrett, PhD,† Ann N. Sieber, RN, MSN,* and John P. Kostuik, MD*

- Largest meta-analysis
- 222 patients - all prolapsed discs
- "there was a significant advantage to treating patients [by decompression] within 48 hours versus more than 48 hours after the onset of cauda equina syndrome"
- > 48 hrs odds ratio persisting deficit:
 - Sensory (3.5), motor (9), bladder (2.5) and bowel function (9)

Spine 2000; vol.25: pgs.1515-22.

Time-Dependent Surgical Outcomes Following Cauda Equina Syndrome Diagnosis

Comments on a Meta-Analysis

Sean S. Kohles, PhD,* David A. Kohles, JD,† Adam P. Karp, MS, JD,‡ Victor M. Erlich, MD, PhD,§ and Nayak L. Polissar, PhD†

- Repeated the meta-analysis
- Statistics flawed
- Understated the value of early surgery
- Surgery <24 hours better than 24-48 hours after onset

Spine 2004; vol.29: pgs.1281-7.

Medico-legal

Delayed Operation or Missed Diagnosis



Poorer Outcome



£500,000 Compensation

Emerging Evidence

- Timing of surgery
 - Topic of ongoing debate
- Britspine 2004 - Mr Sell
 - Prospective longitudinal study
 - 26 pts with 3/12 follow up
- Duration symptoms did NOT influence outcome

Cauda Equina Syndrome

Factors Affecting Long-term Functional and Sphincteric Outcome

Michael J. H. McCarthy, MRCS, Caspar E. W. Aylott, MRCS, Michael P. Grevitt, FRCS(Orth), and James Hegarty, RCN

- The presenting symptoms and signs, the duration before operation, and the speed of onset do not influence the outcome 2 years after surgery.
- Based on the Short Form 36 Health Survey Questionnaire, Low Back Outcome Score, and Oswestry Disability Index scores, patients who have had cauda equina syndrome do not return to a normal status.

SPINE Volume 32, Number 2, pp 207-216

Neuropathology **CES Duration**

- **Neurapraxia**
 - Compression
 - Local conduction block and demyelination
- **Axonotmesis**
 - Traction / Severe Compression
 - Wallerian degeneration
 - Recovery poor
- **Neurotmesis**
 - Severed
 - Requires repair - worst recovery

• But how long? What about the severity of the compression?
• Living system and dynamic process with variation between individuals
• 48Hrs = RUBBISH

Seddon 1943

When to operate

- CES said to occur in ~2% of operated disc prolapses
- What is the actual incidence?
- More importantly - when should we operate on a disc protrusion with no CES? The so called "Impending CES"...
- In our series only 2/42 patients had previous MRI scans and were awaiting surgery
- Risk of 1 in 20??

Recommendations

- If < 24 Hrs from onset of CES - ASAP
- If < 48 Hrs from onset of CES - ASAP
- No evidence to support delay
- If > 48 Hrs from onset of CES - what would you want?
- Suggest MRI facility 0800-2200
- Postpone Operation if 0800-0800
- Impending CES.....? ? ? ? ?

