

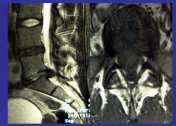
Cauda Equina Syndrome: (1) The Factors Affecting Outcome And (2) An Analysis Of MRI Measurements

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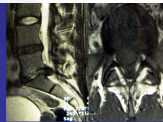
What is cauda equina syndrome?

- No agreed definition
- A spectrum of low back pain, uni / bilateral sciatica, saddle anaesthesia and motor weakness in the lower extremities with variable rectal and urinary symptoms



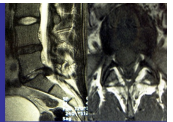
1. Objectives

- Determine the factors which influence the **mid to long term** outcome after surgery for CES
- **Does 48 hours make a difference?**
 - Topic of ongoing debate...
- **Validated Outcome Scores** (not previously done)



2. Objectives

- **Determine whether initial MRI findings correlate with clinical outcomes**
- Study the reproducibility of MRI measurements of large disc protrusions
- **Estimate the ability to predict CES based on MRI alone**
- Assess disc degeneracy in CES



Study Design

1994-2002 Identified 96 patients with CES (coded)

Case note review

56 "true" CES 2° disc -
Evidence of sphincteric disturbance
(MRI - surgical target)

Invited back to clinic

History and Examination and Outcome measures

**31 MRIs
available**

Outcome Measures

Pain Outcome

Visual Analogue Score
Oswestry Disability Index

Back Disability

Oswestry Disability Index
Low Back Outcome Score

Generic Health

Short Form 36 Health
Questionnaire

Psychometric

Modified Somatic
Perception Score
Modified Zung Depression

Male Urogenital

Male Sexual Health
Questionnaire
International Prostate
Severity Score

Female Urogenital

Sheffield Female Pelvic
Floor Questionnaire

Study Design

19 Random patients undergoing discectomy
(with MRI available) identified

Persistent radiculopathy
No sphincteric disturbance

All had a surgical target

Study Design

Digital photographs of all 50 MRIs taken

T2 mid-sagittal image and the
Axial image with greatest disc protrusion

Pairs of images randomized
(numbers from a hat)

50 slide PowerPoint presentation

Observers unaware of numbers in each group

Study Design

Observers:

1 Consultant Radiologist
2 Consultant Spinal Surgeons
1 Senior House Officer

Categorical estimation of
percentage spinal canal
compromise on each view
(0-25, 25-50, 50-75, 75-
100%)

Indicated whether they
thought the
scan findings could produce
CES? Was there
degeneration?

Repeated after 2 weeks

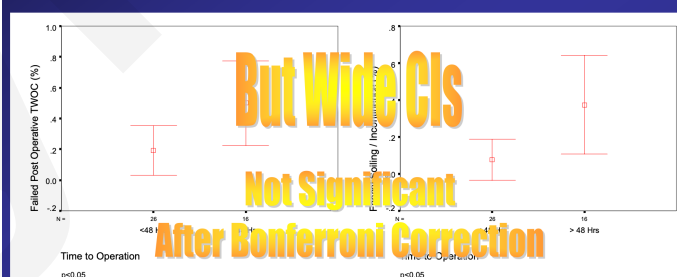
Results

- 42 patients attended follow up (78%)
- Mean age 41yrs (24-67)
- 23M : 19F
- Mean follow up = 60/12 (25-114)
 - minimum 2 years F/U

Results - Mode of Onset

No association with outcomes

Results - Time to Operation

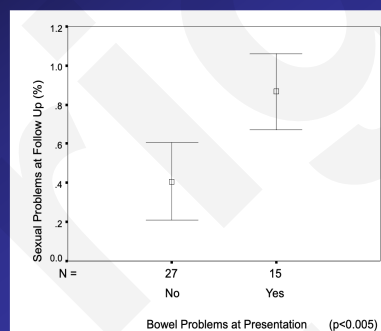


No association with other outcomes

Results - Urological Disturbance

No association with outcomes

Results - Rectal Disturbance

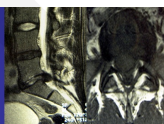


• Bowel problems at presentation associated with

- Sexual problems at follow up (p<0.005)

No association with other outcomes

Results - Level of CES

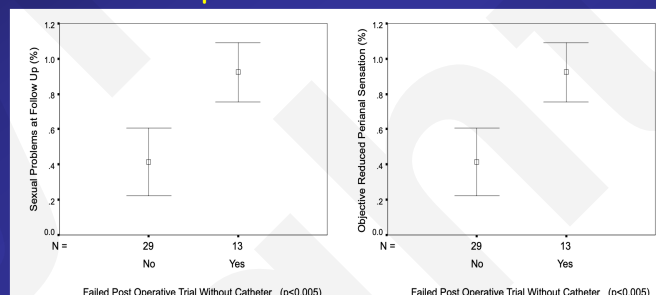


1 L3/4
22 L4/5
19 L5/S1

No association with outcomes

Results - Failed TWOC

- We found no pre-operative factors which predicted a failed TWOC
- At follow up -



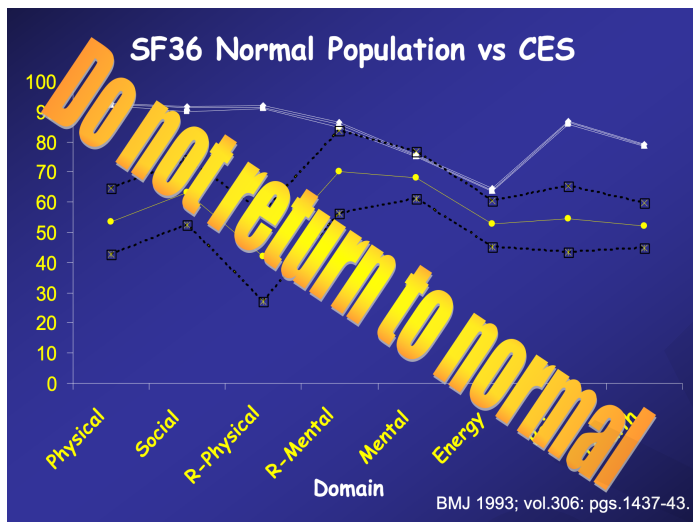
Results - Follow Up Duration

- Duration to F/U ranged 25-114 months
- No association was found between time to follow up and the outcome measures

Results - Mean ODI

	Mean Score	Standard Deviation	95% CI
Normal Population (n=461)	10.2	2.2-12	±1
Primary Low Back Pain (n=2166)	17	5.8-23	± 1
Chronic Low Back Pain (n=1530)	43	15-51	± 1
Cauda Equina Syndrome (n=41)	29	25	± 5

Spine 2000; vol.25: pgs.2940-53.



Results - Mean Outcomes

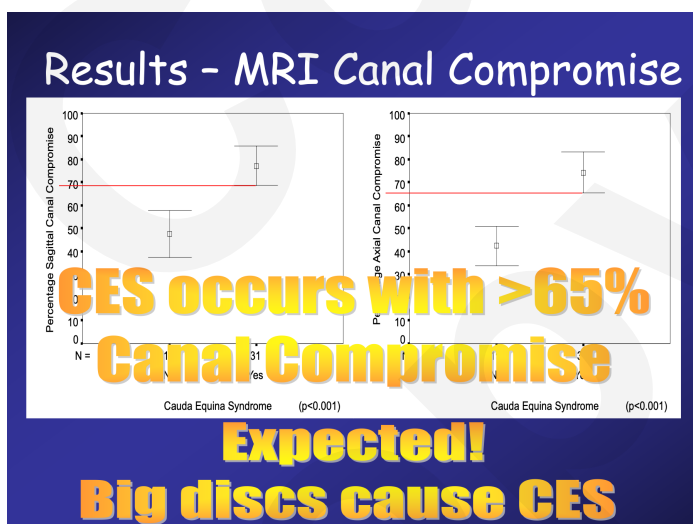
Outcome	Range	CES	Significance
LBOS	0-100	42.3	Fair outcome
MSPQ	0-50	17.1	Good / not somatizing
MZ	0-60	20.4	Borderline Risk
VAS - leg	0-10	3.0	Minimal discomfort
VAS - back	0-10	3.8	Minimal discomfort
VAS	0-10	4.5	Mild discomfort

Results - Mean Outcomes

Outcome	Range	Norm	CES	Significance
IPSS	0-35	<8	10.3	Moderately symptomatic
MSHI	0-25	<10	15.9	Reduced
FPFQ - Bladder	0-100	<20	43.6	Moderately symptomatic
FPFQ - Bowel	0-100	<20	43.6	Moderately symptomatic
FPFQ - Sexual	0-100	<20	43.7	Moderately symptomatic

Outcome Scores

No initial factors influenced the outcome scores



Results - Reproducibility (Kappa)

Observer	% Sagittal Canal Compromise		% Axial Canal Compromise	
	Intra-observer	Inter-observer	Intra-observer	Inter-observer
A	0.85		0.76	
B	0.52		0.53	
C	0.64	0.64	0.74	0.64
D	0.54		0.52	

Results - Degeneration

- CES discs are degenerate (100%)



- >70% degeneration at other levels



- >40% showed adjacent endplate changes

No association with outcomes

Results - Reproducibility (Kappa)

Observer	CES versus non-CES		Number of Responses with Complete Agreement on First and Second Measurements
	Intra-observer	Inter-observer	
A	0.80	0.64	90%
B	0.40		66%
C	0.75		88%
D	0.68		84%

Results - CES

- Based on MRI alone the correct identification of CES has

- Sensitivity 68%

1 in 3 false negative

- Specificity 78%

1 in 5 false positive

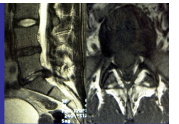
- PPV 84%

MRI CES+ Correct 84%

- NPV 58%

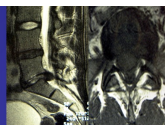
MRI CES- Correct 58%

Conclusions

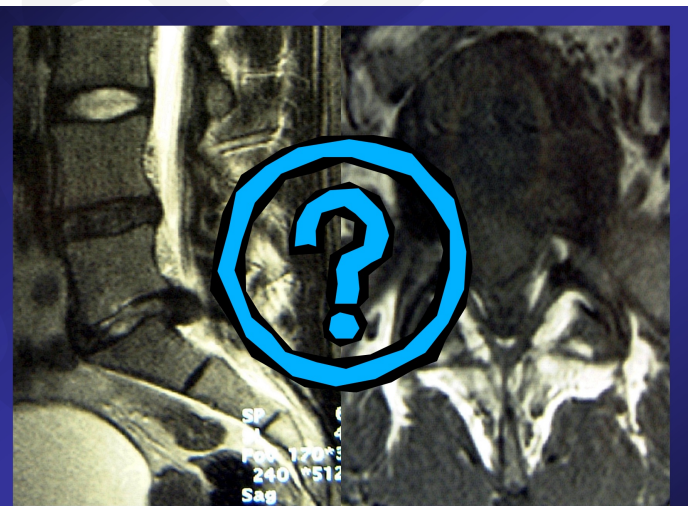


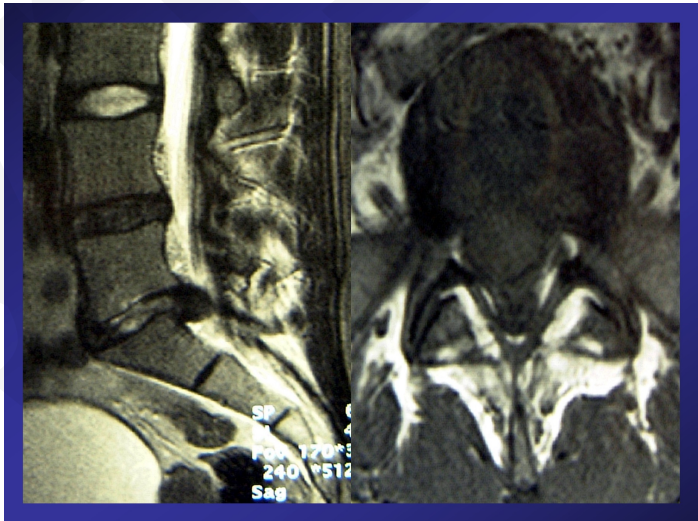
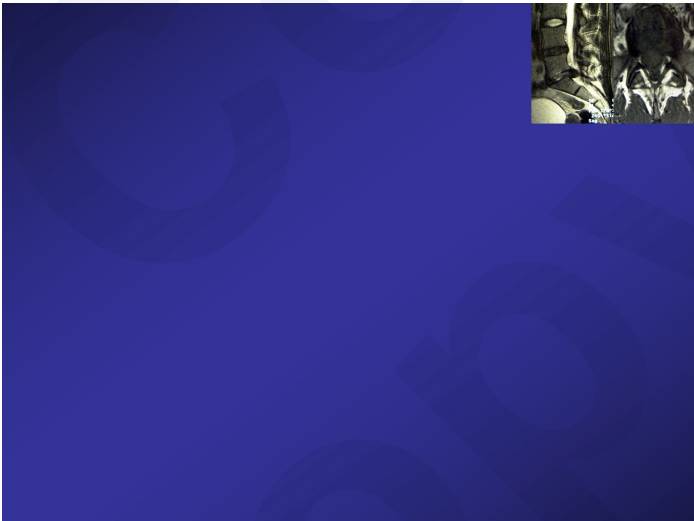
- Duration of symptoms >48 hours and speed of onset does not appear to influence outcome more than two years after surgery
- Based on SF36, ODI and LBOS scores, patients who have had CES do not return to a normal status (mean 5 years F/U)

Conclusions



- CES occurs with >65% canal compromise
 - does not appear to influence clinical outcome
- Reproducibility of MRI measurements has substantial agreement
- CES is a clinical diagnosis supported by MRI
 - In less clear cases (i.e. equivocal symptoms / signs) the presence of a large disc on an MRI scan supports a diagnosis of CES (PPV 84%)





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*

- Large meta-analysis
- 322 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"

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

Emerging Evidence

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

Animal studies

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

Greater Compression = Worse Outcome

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

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

All Recovered

Histology suggests:

Majority of damage done at the time of compression

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

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†

- In collaboration with Lawyers
- Repeated the meta-analysis
- Statistics flawed
- Understated the value of early surgery
- Surgery <24 hours better than 24-48 hours after onset
- "we can neither reproduce nor verify some of the article's sample sizes"

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

Previous Studies

- All small cohorts and heterogenous
- Largest by Shapiro (*Spine* 2000)
 - 44 patients, but 8 had stenosis
- Dinning and Schaeffer (*Aust N Z J Surg* 1993)
 - 39 patients, but 9 had stenosis
- No confidence intervals, graphical representation of results or Bonferroni correction

Posterior Disk Displacement: Morphologic Assessment and Measurement Reliability—Lumbar Spine
 Jeffrey R. Cooley, DC,^a Clark D. Danielson,^b Gary D. Schultz, DC,^c and Timothy A. Hall, DC^d

- Reproducibility of disc displacement assessments and digital vs. handruler measurements on MRIs
 - Inter-observer agreement good
 - Intra-observer agreement lower than expected
- Small discs (measurement error could increase with larger discs)
- No clinical correlations

JMPT 2001; vol.24: pgs.317-26.

Observer Variability in Assessing Lumbar Spinal Stenosis Severity on Magnetic Resonance Imaging and Its Relation to Cross-Sectional Spinal Canal Area

Alex C. Speciale, MD, Ricardo Pietrobon, MD, Chris W. Urban, MD, William J. Richardson, MD, Clyde A. Helms, MD, Nancy Major, MD, David Enterline, MD, Lloyd Hey, MS, MD, Michael Haglund, MD, PhD, and Dennis A. Turner, MA, MD

- MRI reproducibility in lumbar stenosis
 - Subjective classification mild / mod / severe
 - Fair level of agreement
- No clinical correlations

Spine 2002; vol.27: pgs.1082-6.

Results - Symptoms

	Initial Presentation Prevalence (%)	Follow Up (% of those from Onset)
Low Back Pain	35 (83%)	2 (6%)
Sciatica	38 (90%)	4 (11%)
Retention	25 (60%)	6 (24%)
Incontinence	23 (55%)	10 (43%)

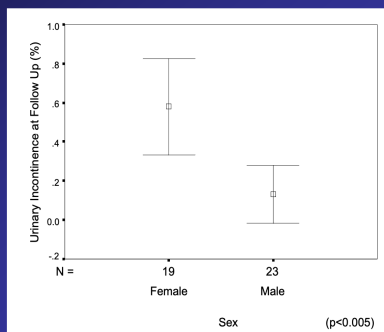
Results - Signs

	Initial Presentation Prevalence (%)	Follow Up (% of those from Onset)
Leg Weakness	23 (55%)	12 (52%)
Abnormal Leg Sensation	26 (62%)	12 (46%)
Abnormal Ankle Jerk	26 (62%)	24 (92%)
Abnormal Rectal Sens	32 (76%)	21 (66%)
Abnormal Rectal Tone	21 (50%)	5 (25%)

Results - Increasing Age

No association with outcomes

Results - Sex



- Female sex associated with
 - Urinary incontinence at follow up (p<0.005) ?expected

No association with other outcomes

Litigation, Lifting, Accident

- Litigation 4/42 (10%)
- Lifting 7/42 (16%)
- Accident 9/42 (21%)

No association with outcomes

Complications

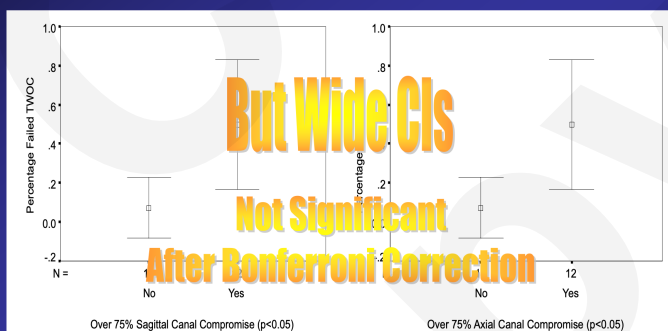
- 5 Dural tears - 2 required re-operation
- 4 Superficial infections - no op intervention
- 2 Incontinent of Urine + Faeces
 - prior rectal tone normal, both had laminotomy
- 1 Haematoma - required washout
- 1 Recurrent Disc - re-operation
- 1 Meningocele - no op intervention

33%

Results - MRI Canal Compromise

- 12 / 26 patients had, on average, >75% canal compromise
 - Bodner et al. 1990 J Urol - Dogs
 - Significantly worse outcomes with 75% compression compared to 50%
- Our study - **NO** direct association between canal compromise and clinical outcome
- But...

Results - MRI Canal Compromise



- Failed TWOC found to be associated

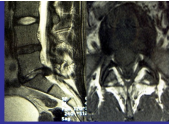
Results - Levels

- Level of CES
- Presence of other disc degeneration
- No association with outcomes

Results - Reproducibility (Kappa)

	CES Discs Assessed as Degen.	Degeneration of the CES Disc		Endplate Changes CES Disc		Other Disc Degeneration	
		Intra-observer	Inter-observer	Intra-observer	Inter-observer	Intra-observer	Inter-observer
A	100%	1		0.80		0.84	
B	100%	1	1	0.93	0.84	0.79	0.71
C	NA	NA		NA		NA	
D	100%	1		0.80		-0.71	

Conclusions



- CES is a clinical diagnosis supported by an MRI scan
- In less clear cases (i.e. equivocal symptoms / signs) the presence of a large disc on an MRI scan supports a diagnosis of CES (PPV 84%)
- CES occurs in degenerate discs

