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Incidence & Prevalence of Surgery at Segments Adjacent to a Previous Posterior Lumbar Arthrodesis

Sears W, Sergides I, Smith M, Kazemi N, Osburg B, White G.

**Health-Related Quality of Life:
Comparison following
Fusion for Lumbar Degenerative Spondylolisthesis
with Hip & Knee Joint Replacement Surgery
& with Population norms**

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& Gavin White¥**

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- Author – O.W. Nil
- Author – G.W.
 - » Consultant: Medtronic (Major)

“Never let anyone touch your back”

Objectives

1. Measure the Quality-of-Life of patients (HRQL) :
 - common & specific spinal disorder,
 - specific decompression and fusion technique,
 - generic measurement instrument
2. Compare these HRQL measurements with:
 - hip or knee surgery
 - total joint arthroplasty,
 - population norms
 - published, age-matched.

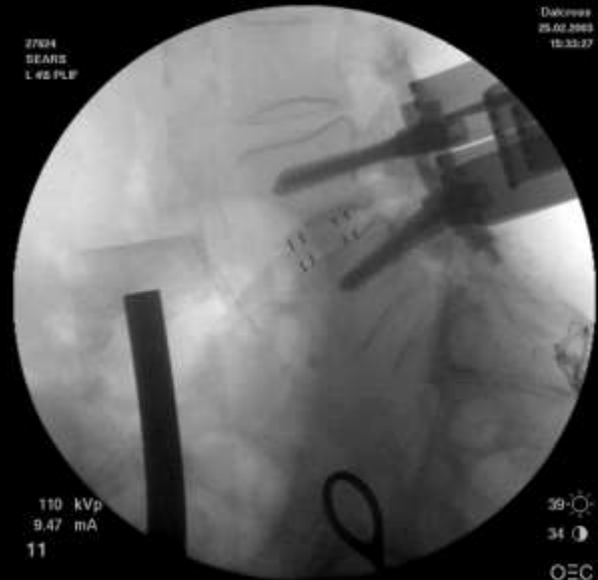
Methods

- Study design:
 - Prospective
 - Consecutive case series
 - 2 independent surgeons
 - Comparison with published literature (Hips, Knees, Norms)
- Inclusion Criteria:
 - Clinical:
 - neurogenic claudication
 - no previous surgery
 - failed conservative management
 - Radiological:
 - single level, lumbar spinal stenosis
 - ‘unstable’ degenerative spondylolisthesis

Female 56 yrs



Surgical Technique





Methods

- Data Collection:
 - Baseline demographics
 - SF-12
 - Physical Component Summary score (PCS-12)
 - Mental Component Summary score (MCS-12)
 - Follow-up:
 - 3, 6, 12, 24 months & last known (minimum - 12 months)

SF12

- Generic HRQoL measure
 - Physical (PCS-12) & Mental (MCS-12) components
 - Allows comparison of health status of different conditions
- A 5 point or greater score change is clinically important*

* Bozic KJ et al. *J Bone Joint Surg Am* 2003

Copay AG et al. *Spine J*, In press

Methods

- Data Collection:
 - SF-12
 - Physical Component Summary score (PCS-12)
 - Mental Component Summary score (MCS-12)
 - Follow-up:
 - 3, 6, 12, 24 months & last known (minimum - 12 months)
- Systematic literature review:
 - 1950 to March 2008
 - MeSH terms:
 - “Arthroplasty, Replacement, Hip” or “Arthroplasty, Replacement, Knee”
 - Keyword: “SF-12”.
 - Means and 95% CI’s
- Population Norms:
 - South Australian, *Avery et al, 2004*.
 - Age-matched (IQR)

Methods

- Data analysis:
 - Descriptive statistics: means and 95%CI's
 - Participant demographics
 - Pre-, post-operative & change PCS-12 and MCS-12 scores.
 - Wilcoxon signed-rank test:
 - Comparison of pre- and post-operative scores.
 - Group comparisons
 - Overlapping 95% CIs
 - T test (unequal numbers, unequal variance assumed)
 - XLSTAT version 7.5.3 software

Results

Baseline demographics

	Spine	Hip	Knee	Population norms
Studies		2	3	1
Number	98	276	791	455
Females (%)	73*	44	59	51
Age (mean, range)	67 (46-90)	62 (22-89)	69 (29-83)	55-74
Pre-op PCS-12 (mean, 95%CI)	28 (27-30)	30 (28-31)	30 (29-31)	44 (42-45)
Pre-op MCS-12 (mean, 95%CI)	48 (46-50)	47 (46-49)	53 (52-54)	54 (53-54)

* p<0.001 compared with all other groups

Results

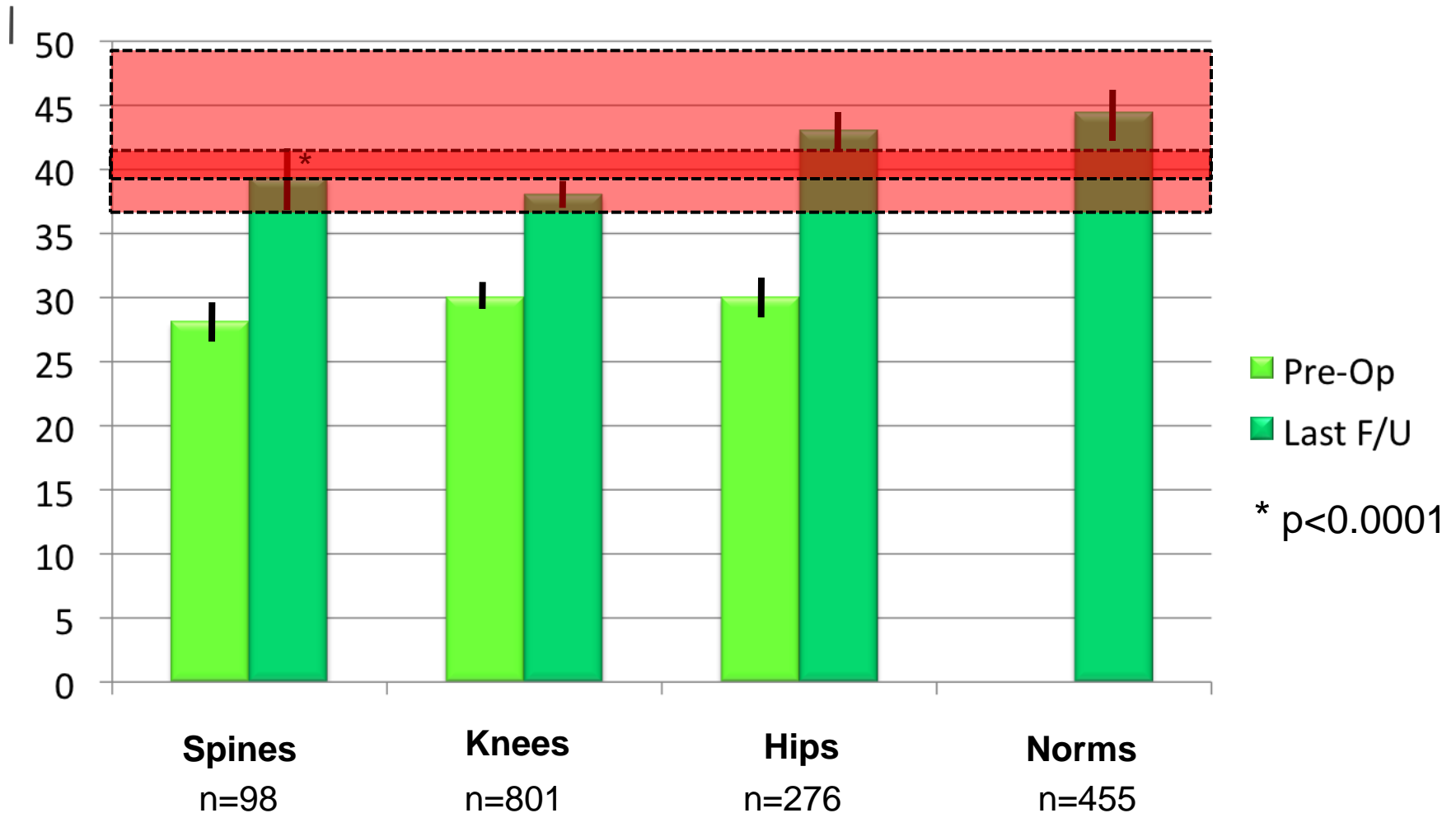
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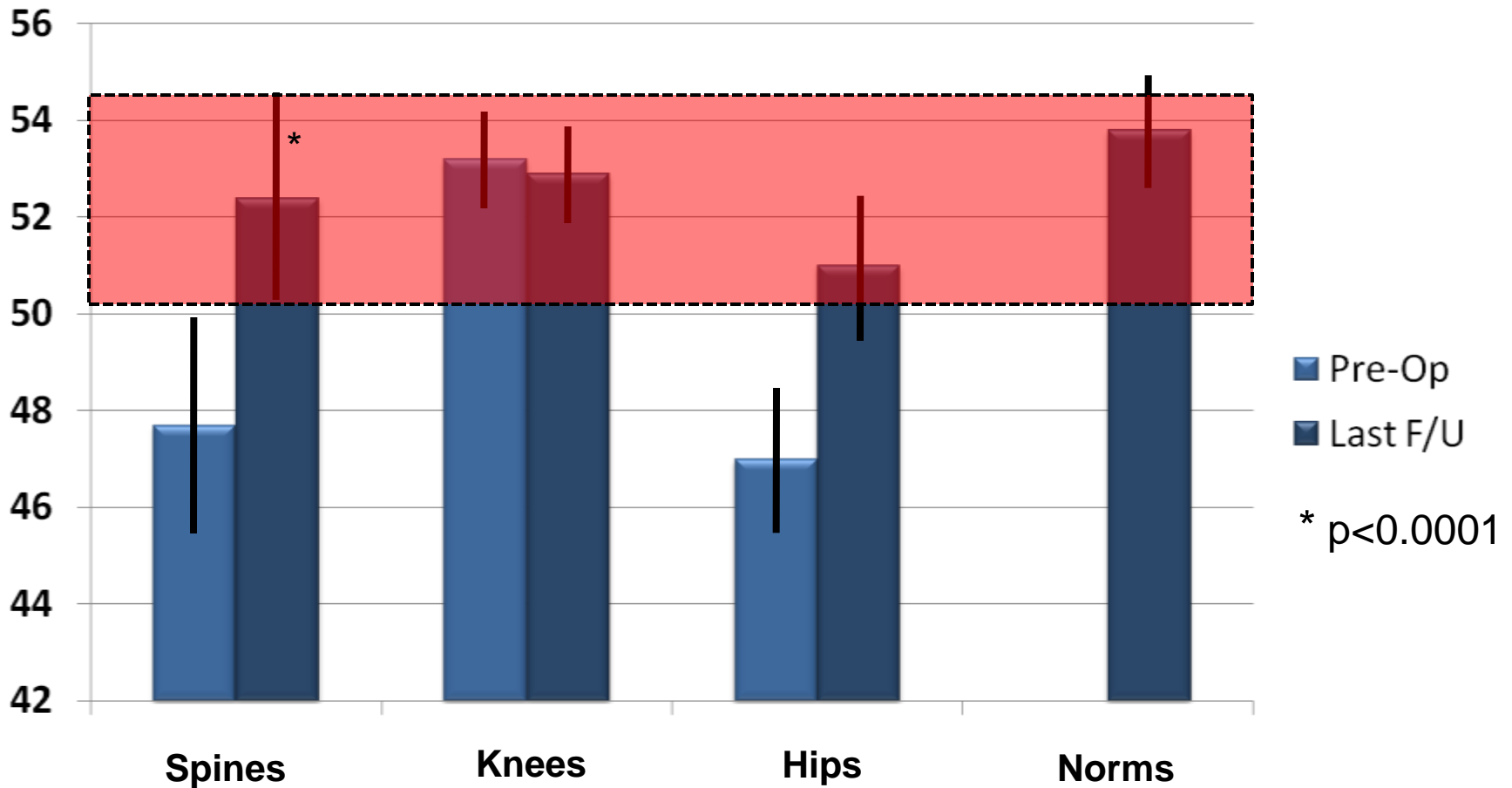
Results

PCS-12 (means \pm detectable difference)



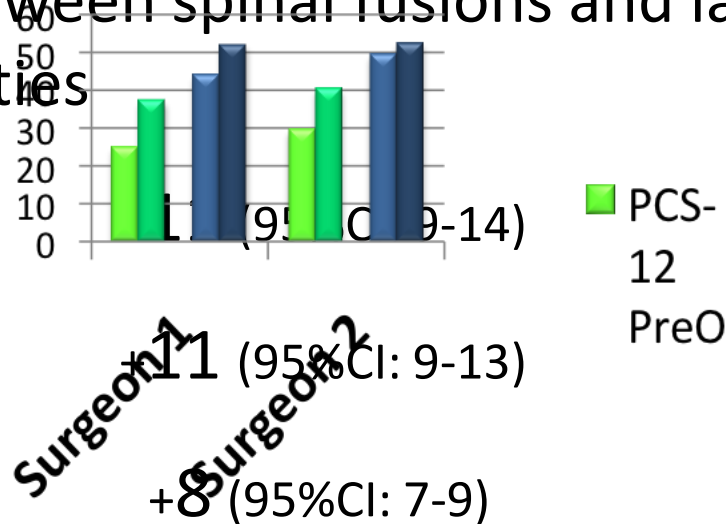
Results

MCS – 12 (means, 95% CI)



Discussion

- PCS-12 change scores:
 - No difference between spine surgeons: +12 vs. +11
 - Similar between spinal fusions and large joint arthroplasties



- Spines:

- Hips:

- Knees:

Conclusion

- \uparrow Quality of Life ***Spine*** = \uparrow Quality of Life ***Knee & Hips***
- \uparrow Quality of Life ***Spine*** \approx Quality of Life ***Norms***

References:

– Spine surgery:

- Polly DW et al. SF-36 PCS Benefit-Cost Ratio of Lumbar Fusion Comparison to Other Surgical Interventions A Thought Experiment *Spine* 2007
- Rampersuad YR et al. Assessment of Health-Related Quality of Life following surgical treatment of focal symptomatic spinal stenosis compared to osteoarthritis of the hip or knee. *Spine J*, 2008



– THR:

- Ostendorf et al. *JBJS (Br)* 2004
- Danesh-Clough. *J Arthroplasty* 2007

– TKR:

- Hartley et al. *JBJS* 2002
- Muller et al. *JBJS (Br)* 2006
- Bourne et al. *Clin Orth* 2007

– Population norms:

- Avery et al. Quality of Life in South Australia measured by SF-12. *Population Research & Outcome Studies Unit, Dept Human Services, South Australia*, 2004

Incidence & Prevalence of Surgery at Segments Adjacent to a Previous Posterior Lumbar Arthrodesis.

Sears W, Kazemi N, Sergides I, Smith M, Osburg B, White G.

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EuroSpine 2010

Vienna

17th September 2010

Disclosures

- Sears
 - Consultant: Medtronic, Paradigm Spine
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- Sergides
 - Fellowship support: Medtronic
- White
 - Consultant: Medtronic

Background

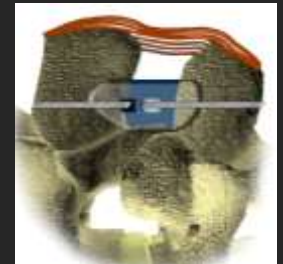
Lumbar Adjacent Segment Disease



Fusion disease... or natural history?

Background

Lumbar Adjacent Segment Disease



Background

Published Literature – *Biomechanical*

- ↑ stresses at levels adjacent to a fusion
 - Chen *et al. Med Eng PHys* 2001,
 - Chow *et al. Spine* 1996,
 - Cunningham *et al. Spine* 1997,
 - Eck *et al. Am J Orthop* 1999,
 - Lee *et al. Spine* 1984,
 - Oda *et al. Spine* 2000,
 - Umehara *et al. Spine* 2000
 - Rao *et al. Spine* 2005
 - Sudo *et al. J Neurosurg Spine* 2006

Background

Published Literature – *Clinical*

- Controversial – fusion disease or natural history?
- Prevalence:
 - Radiological degeneration: 5.2% - 100%
 - Symptomatic disease: 5.2% - 18.5% (Harrop *et al*, *Spine* 2008)
 - Relatively small series: n = 21-215
- Annual Incidence:
 - Cervical –
 - Hilibrand *et al*, *JBJS* 1999 – 2.9%

**Radiculopathy and Myelopathy at Segments Adjacent to
the Site of a Previous Anterior Cervical Arthrodesis***

BY ALAN S. HILIBRAND, M.D.†, GREGORY D. CARLSON, M.D.‡, MARK A. PALUMBO, M.D.§,
PAUL K. JONES, PH.D.¶, AND HENRY H. BOHLMAN, M.D.‡, CLEVELAND, OHIO

*Investigation performed at the Department of Orthopaedic Surgery, University Hospitals Spine Institute,
Case Western Reserve University School of Medicine, Cleveland*

Background

Published Literature – *Clinical*

- Controversial – fusion disease or natural history?
- Prevalence:
 - Radiological degeneration: 5.2% - 100%
 - Symptomatic disease: 5.2% - 18.5% (Harrop *et al*, *Spine* 2008)
 - Relatively small series: n = 21-215
- Annual Incidence:
 - Cervical –
 - ▣ Hilibrand *et al*, *JBJS* 1999 – 2.9%
 - Lumbar –
 - ▣ Ghiselli *et al*, *JBJS* 2004 – 3.9% (n=215)
- Risk factors ? – esp. Number of levels fused

Aims

1. Determine

- Annual incidence
- Prevalence

surgical intervention for ASD following lumbar arthrodesis

2. Examine

- Relative risk factors

Methodology

- Retrospective cohort analysis
- End points:
 - Further surgical intervention - at adjacent level
 - Death / loss to F/U
- Postal & telephone survey:
 - “Have you had further surgery?”
 - If so:
 - ▣ when?
 - ▣ what type?
 - ▣ where/by whom?

Study Population

- 912 patients, 1000 consecutive PLIF procedures
 - October 1993 – November 2009
 - Mean age: 63 yrs (range: 14-92)
 - Female : Male – 1.4 : 1
- Inclusion criteria:
 - Lumbar degenerative pathology
 - Failed conservative management
 - Clinical symptoms and radiological signs → fusion levels
- Exclusion criteria:
 - Acute fracture/dislocation or malignancy
- Follow-up:
 - 91 % patients, 92 % procedures

Surgical Technique

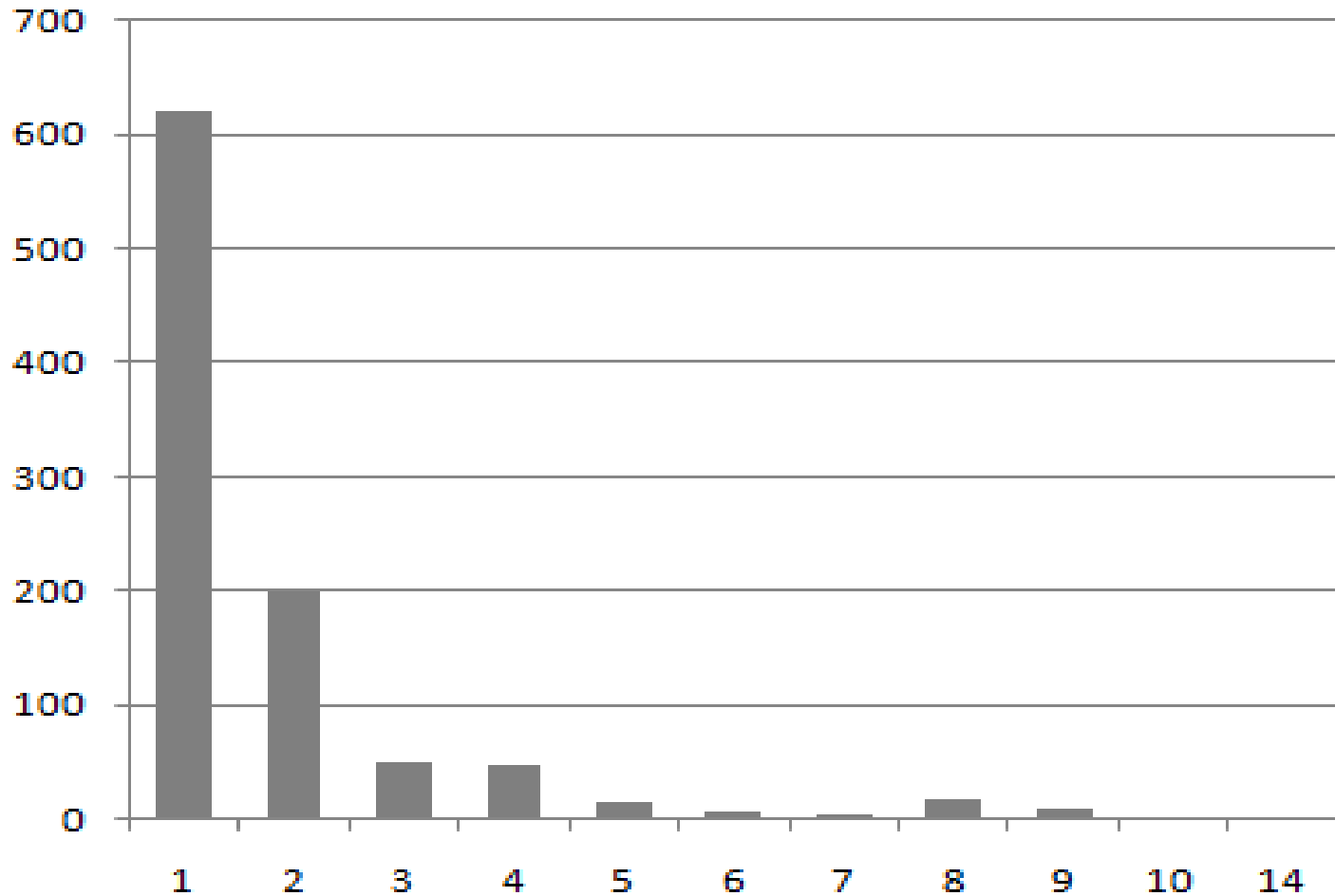
- Posterior lumbar interbody fusion (PLIF)
 - Insert & rotate interbody spacers
 - Pedicle screw instrumentation
- Attempted restoration of coronal and sagittal balance



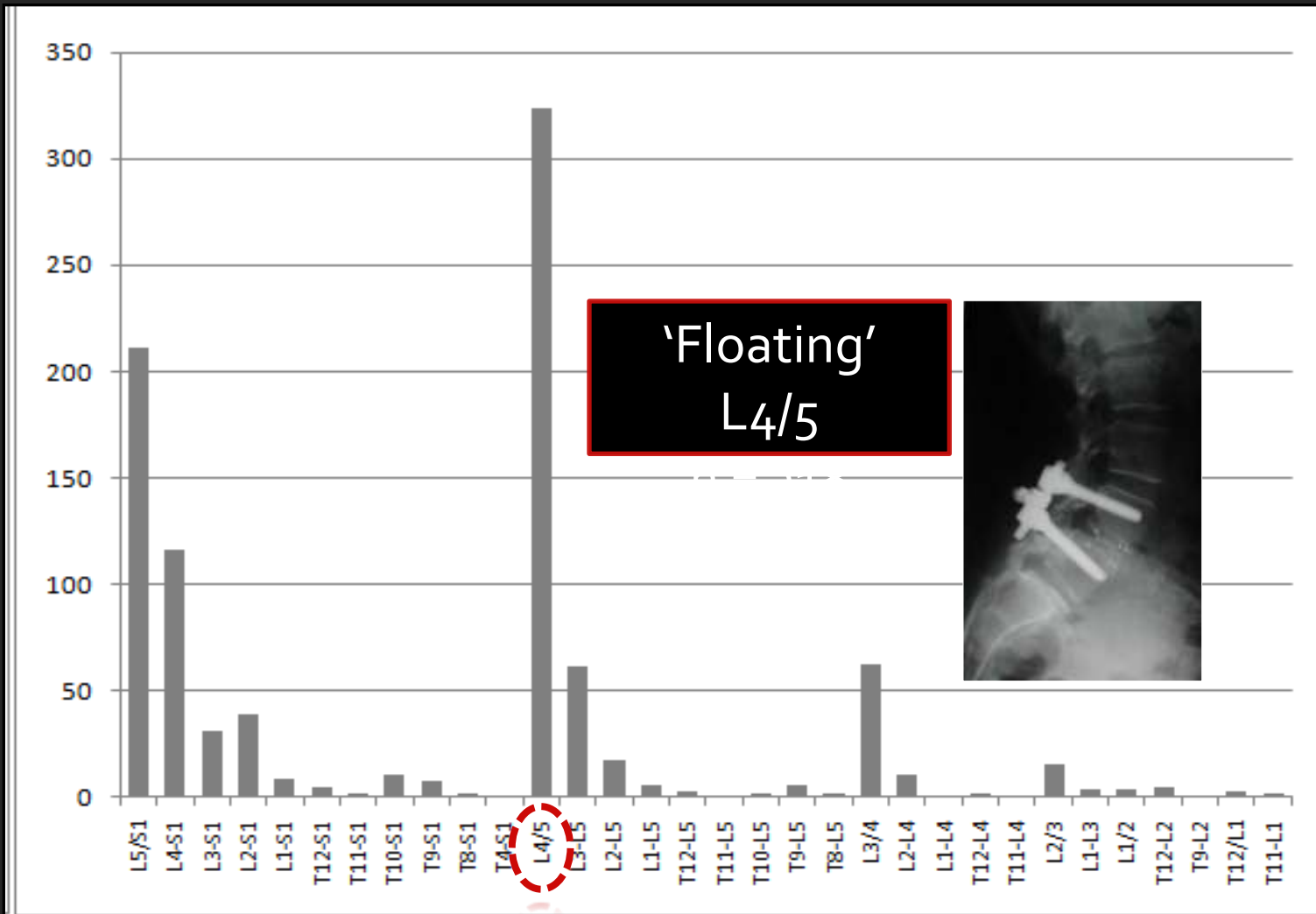
Surgical Technique



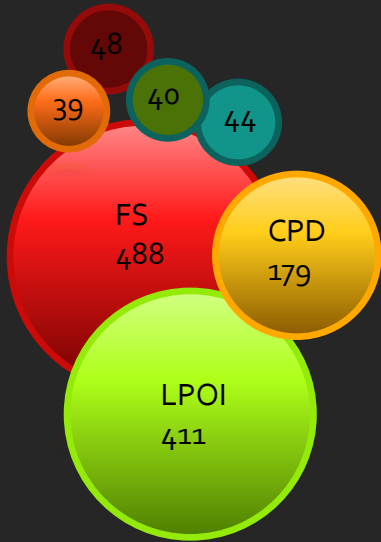
Numbers of Levels fused



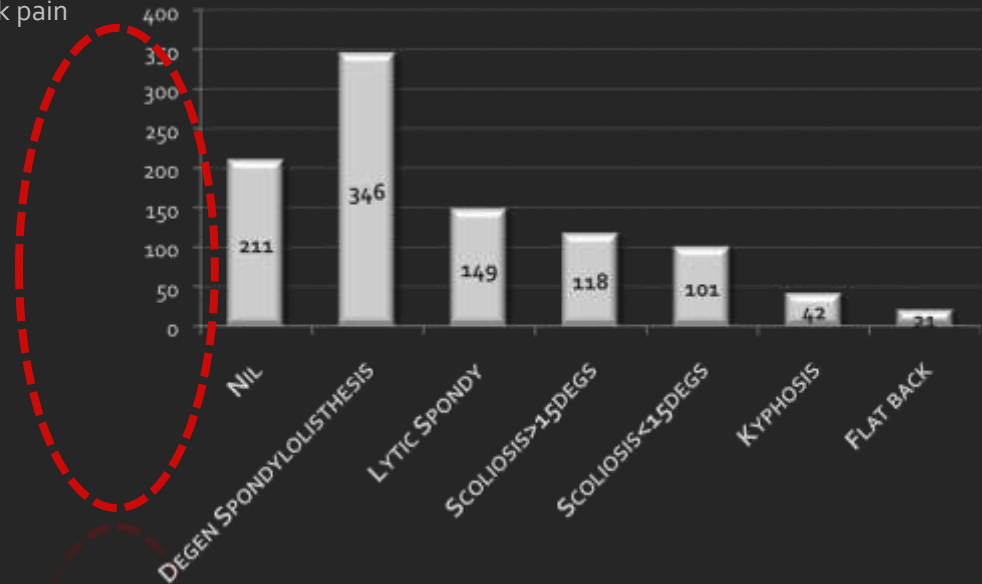
Levels fused



Indications



- Foraminal stenosis
- Likely post op instability
- Correct painful deformity
- Non-union
- Large or Recurrent disc herniation
- Discogenic back pain
- Instability



Statistical analysis

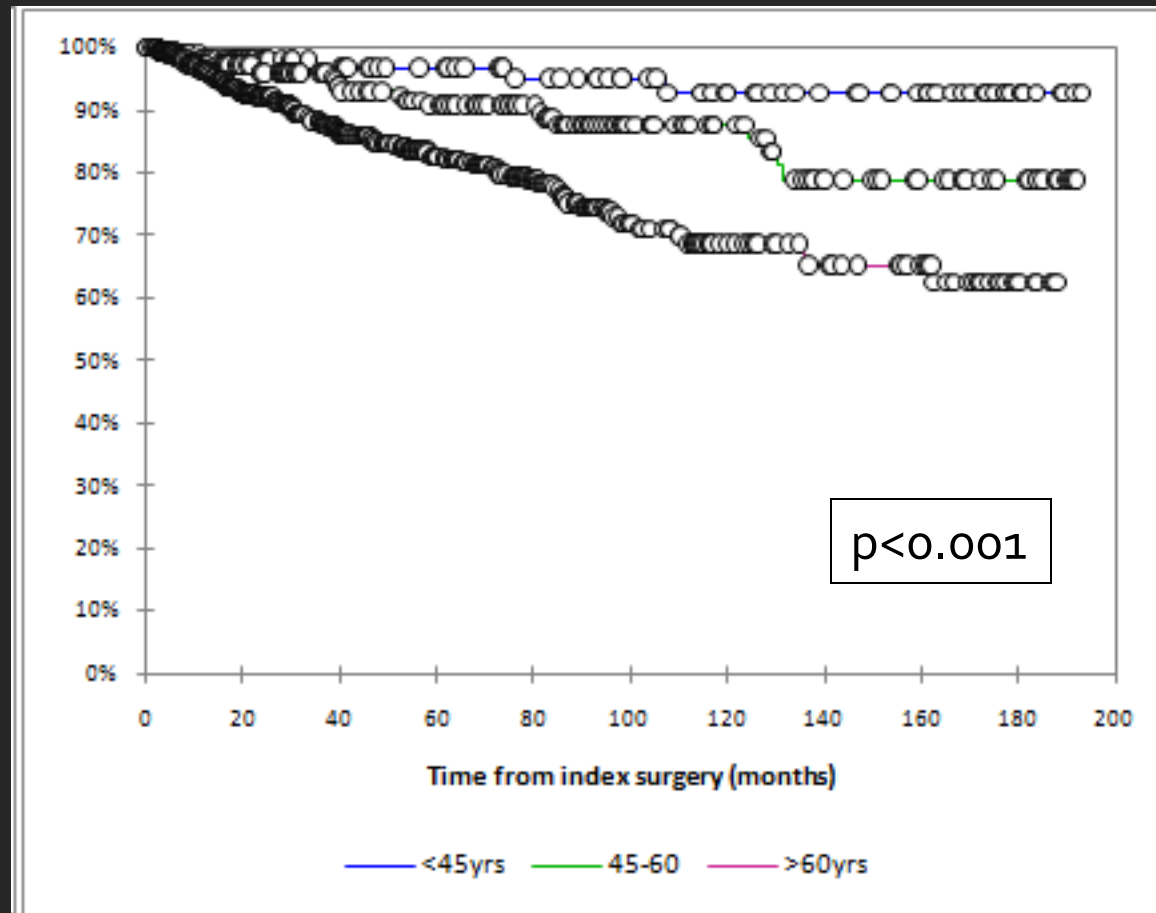
- Kaplan-Meier survivorship analysis –
 - ▢ Prevalence & annual Incidence
- Cox proportional-hazards regression –
 - ▢ Multivariate analysis of risk factors
- Xlstat version 2009.6.03 & Medcalc version 11.2.1.0
- Significance set at $p < 0.05$

Results

- Prevalence:
 - 130 / 1000 procedures – 13% (*mean f/u: 63 months*)
 - ▢ 12 laminectomy
 - ▢ 118 further fusions
- Mean time to further surgery – 43 months (*range: 2.3 – 162*)
- Annual incidence (*all patients*) – 2.5% (*95%CI: 1.9-3.1*)

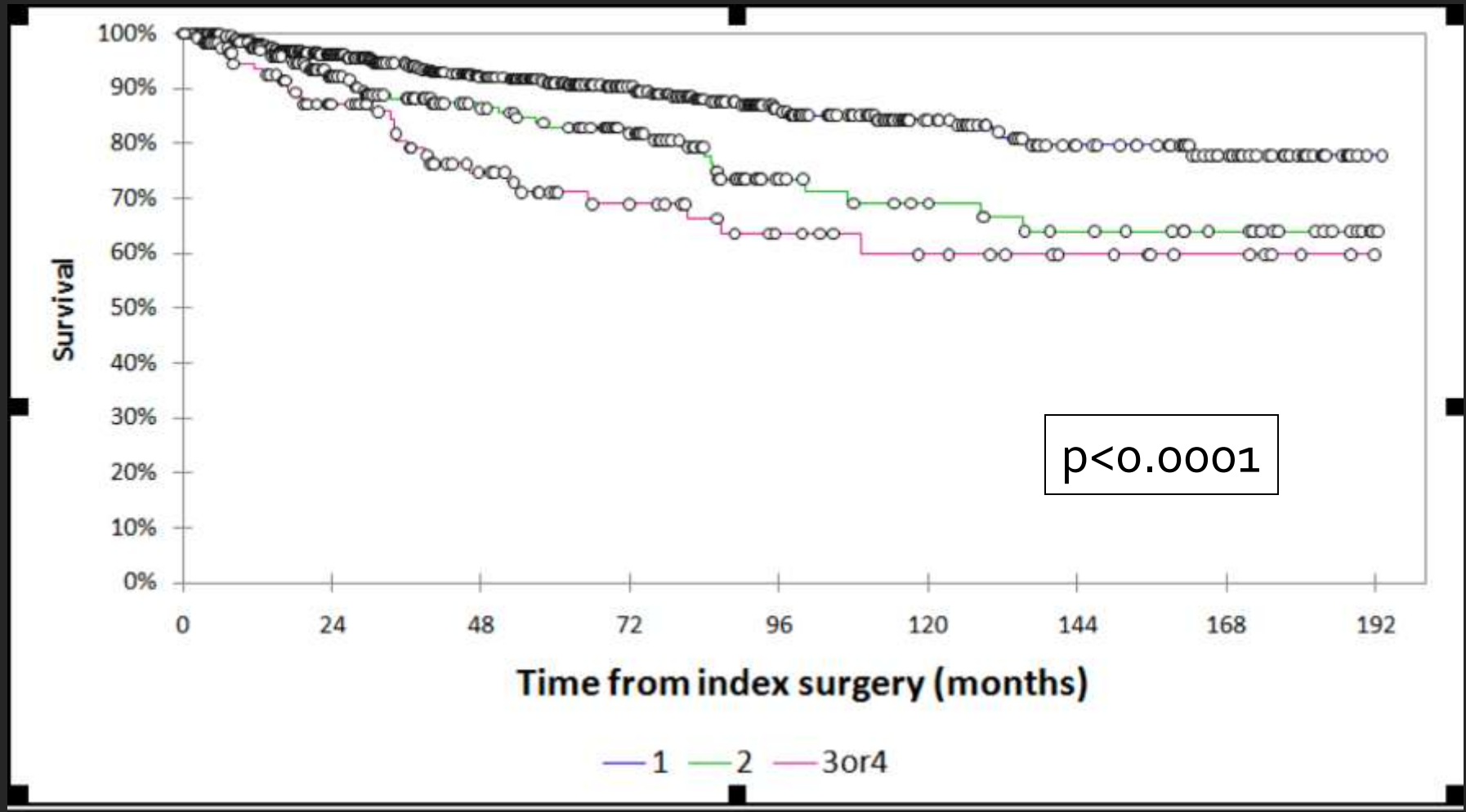
Kaplan Meier Survivorship Analysis

Age groups: <45, 45-60, >60 years



Kaplan Meier Survivorship Analysis

Number of Levels Fused: 1, 2, 3 & 4

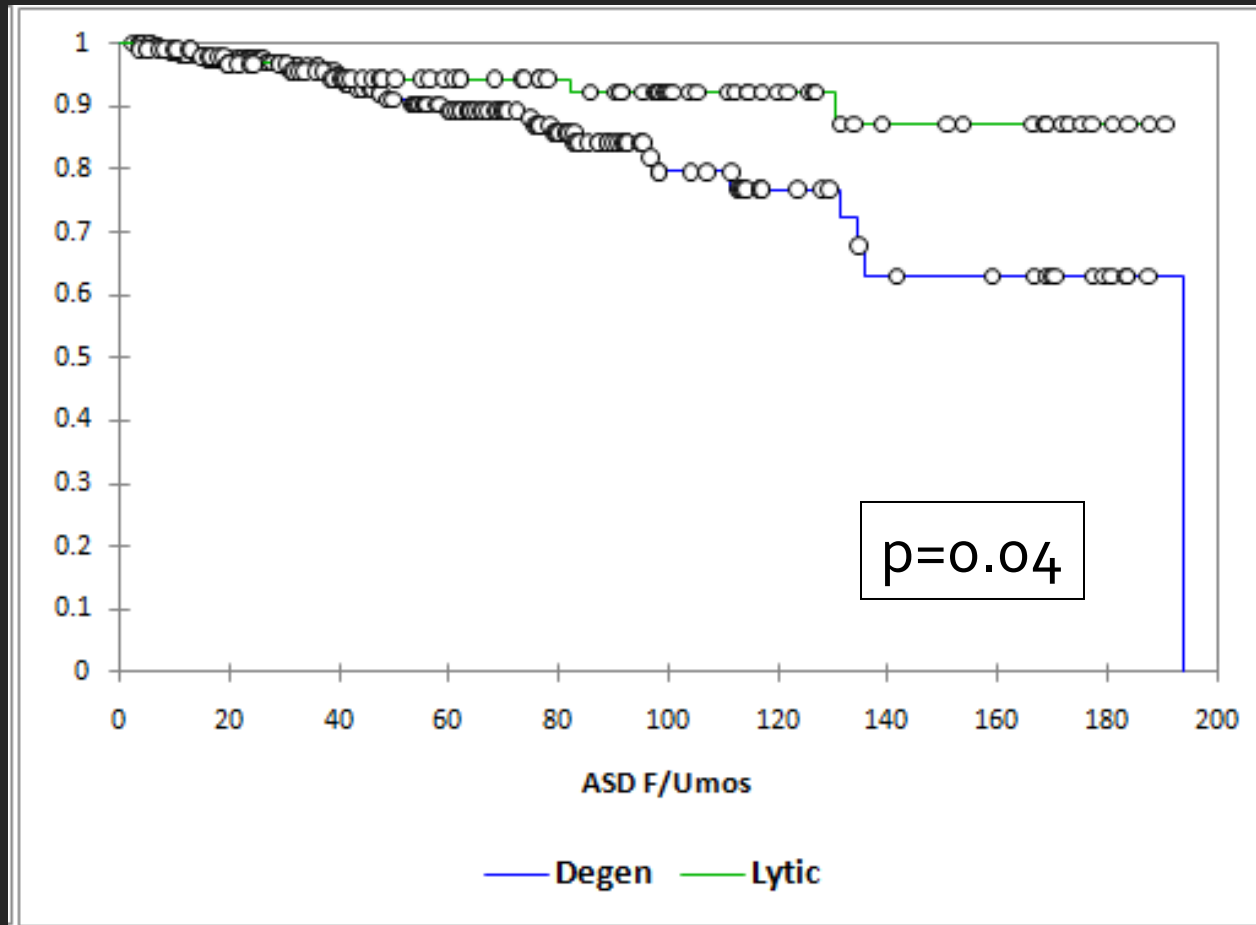


Annual Incidence & Prevalence vs. Number of Levels Fused

<i>No. of Levels Fused</i>	Annual Incidence (95%CI)	Prevalence <i>5 year</i>	Prevalence <i>10 year</i>
Mixed (all patients)	2.5 % (1.9-3.1)	14 %	22 %
1	1.7 % (1.3-2.2)	9 %	16 %
2	3.6 % (2.1-5.2)	17 %	31 %
3 & 4	5.0 % (3.3-6.7)	29 %	40 %

Kaplan Meier Survivorship Analysis

Lytic (n=103) vs. Degenerative Spondylolistheses (n=221)



Annual Incidence & Prevalence

Lytic (n=103) vs. Degenerative Spondylolistheses (n=221)

Spondy Type	Annual Incidence (95%CI)	5 year Prevalence	10 year Prevalence
Lytic	1.1 % (0.3-1.8)	6 %	8 %
Degen.	2.4 % (0.7-4.1)	11 %	27 %

p=0.04

Multivariate Risk Factor Analysis

(Cox proportional-hazards regression)

- Age –
 - < 45 (n=130)
 - 45-60 (n=199)
 - > 60-years (n=671)
- Number of levels fused –
 - 1-level (n=593)
 - 2-levels (n=216)
 - 3 or 4 levels (n=117) and 5+ levels (n=60)
- Sex – male or female
- Previous surgery – 0-6
- Laminectomy adjacent (to the index fused levels)
- Level of the Distal fused vertebra – L₁, L₂, L₃, L₄, L₅ or S₁
- Deformity – Nil, degen spondy, lytic spondy, scoliosis < 15degs, scoliosis > 15degs, kyphosis/flat-back

Covariate	b	SE	P	Exp(b)	95% CI of Exp(b)
Age = 45-60yrs	-0.587	0.24	0.012	0.55	0.34 to 0.87
Age = <45yrs	-1.364	0.47	0.003	0.25	0.10 to 0.63
Levels_fused = 3 or 4	1.121	0.24	<0.0001	3.0	1.89 to 4.86
Levels_fused = 2	0.775	0.21	0.0003	2.1	1.42 to 3.25
Lowest_lev = L ₅	0.498	0.19	0.007	1.7	1.15 to 2.41
Additional Laminectomy	0.870	0.40	0.03	2.4	1.09 to 5.17

Multivariate Risk Factor Analysis

(Cox proportional-hazards regression)

Covariate	Relative Risk (95%CI)	P value
Age = <45yrs	x 0.25 (0.10 to 0.63)	0.003
Age = 45-60yrs	x 0.55 (0.34 to 0.87)	0.01
2 levels fused	x 2.1 (1.42 to 3.25)	0.0003
3 or 4 levels fused	x 3.0 (1.89 to 4.86)	<0.0001
Lowest level fused = L5	x 1.7 (1.15 to 2.41)	0.007
Adjacent level laminectomy	x 2.4 (1.09 to 5.17)	0.03

Discussion

- Methodology:
 - Single surgeon
 - Single technique
 - ▢ His/her indications
 - ➔
 - ▢ *Advantages*
 - ✦ Reduction in confounding variables
 - ✦ Facilitates multi-variant analysis
 - ▢ *Disadvantages*
 - ✦ Care required in applying to other surgeons/techniques
- End-point of further surgery may underestimate true incidence

Further study

- Examine role of pre-existing adjacent segment disease
- Examine role of sagittal and coronal balance
- Larger cohorts of specific pathologies
- ???

Conclusions

- Average annual incidence further surgery for ASD : 2.5%

but... incidence is not uniform

Conclusions

- ASD risk factors:
 - Number of levels fused ($p < 0.0001$)
 - ▢ Risk –
 - ◇ 1.7 % for one level
 - ◇ x 2 for two levels – 3.6%
 - ◇ x 3 for 3/4 levels – 5%
 - (10-year prevalence of 40 %)

Conclusions

- ASD incidence factors:
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 - Age ($p < 0.001$)
 - ▢ especially < 45 years – risk: x 0.25 (cf. 60+yrs)

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 - ▣ Risk –
 - ◇ 1.7 % for one level
 - ◇ x 2 for two levels – 3.6%
 - ◇ x 3 for 3/4 levels – 5%
 - (10-year prevalence of 40 %)
 - Age ($p < 0.001$)
 - ▣ especially < 45 years – risk: x 0.25 (cf. 60+yrs)
 - Take care when interpreting ASD rates - especially following single level surgery in young patients – e.g. in US IDE disc prosthesis studies

Thank you!