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

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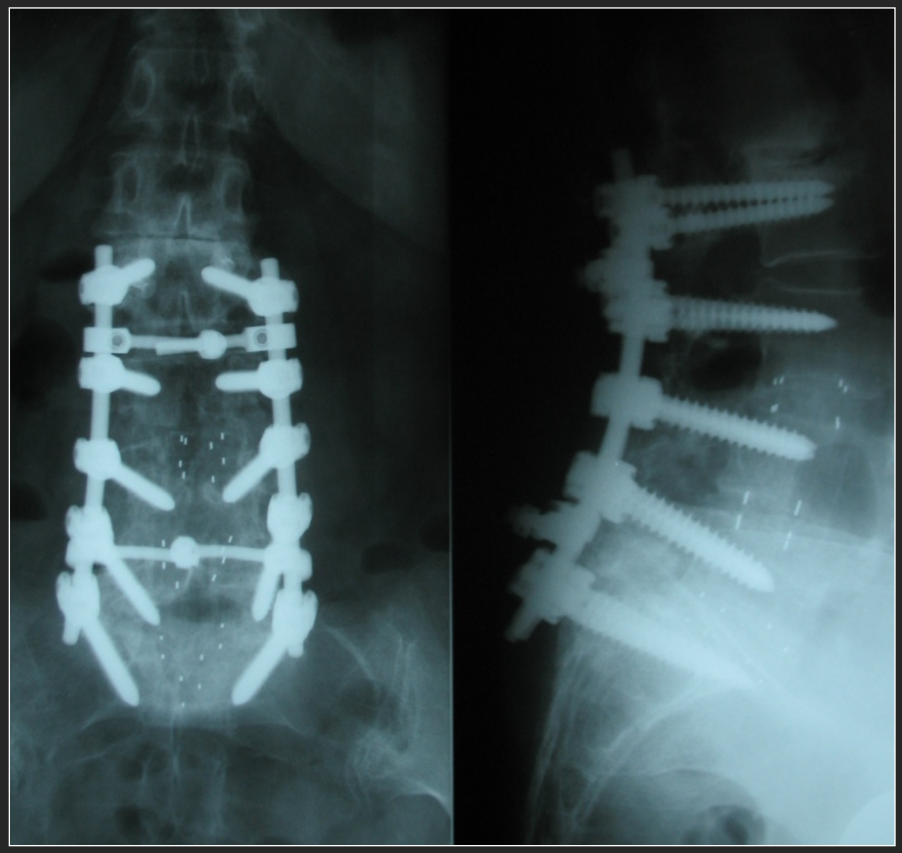
Disclosures

- Sears
  - Consultant: Medtronic, Paradigm Spine
  - Royalties: Medtronic – interbody fusion device
- Sergides
  - Fellowship support: Medtronic
- White
  - Consultant: Medtronic

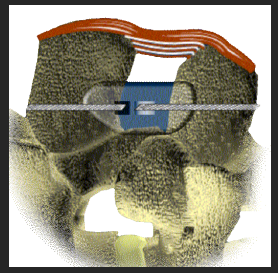
Background
Lumbar Adjacent Segment Disease

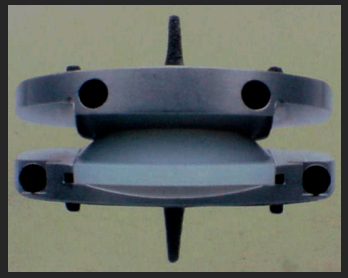


Fusion disease… or natural history?

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%
  - 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?

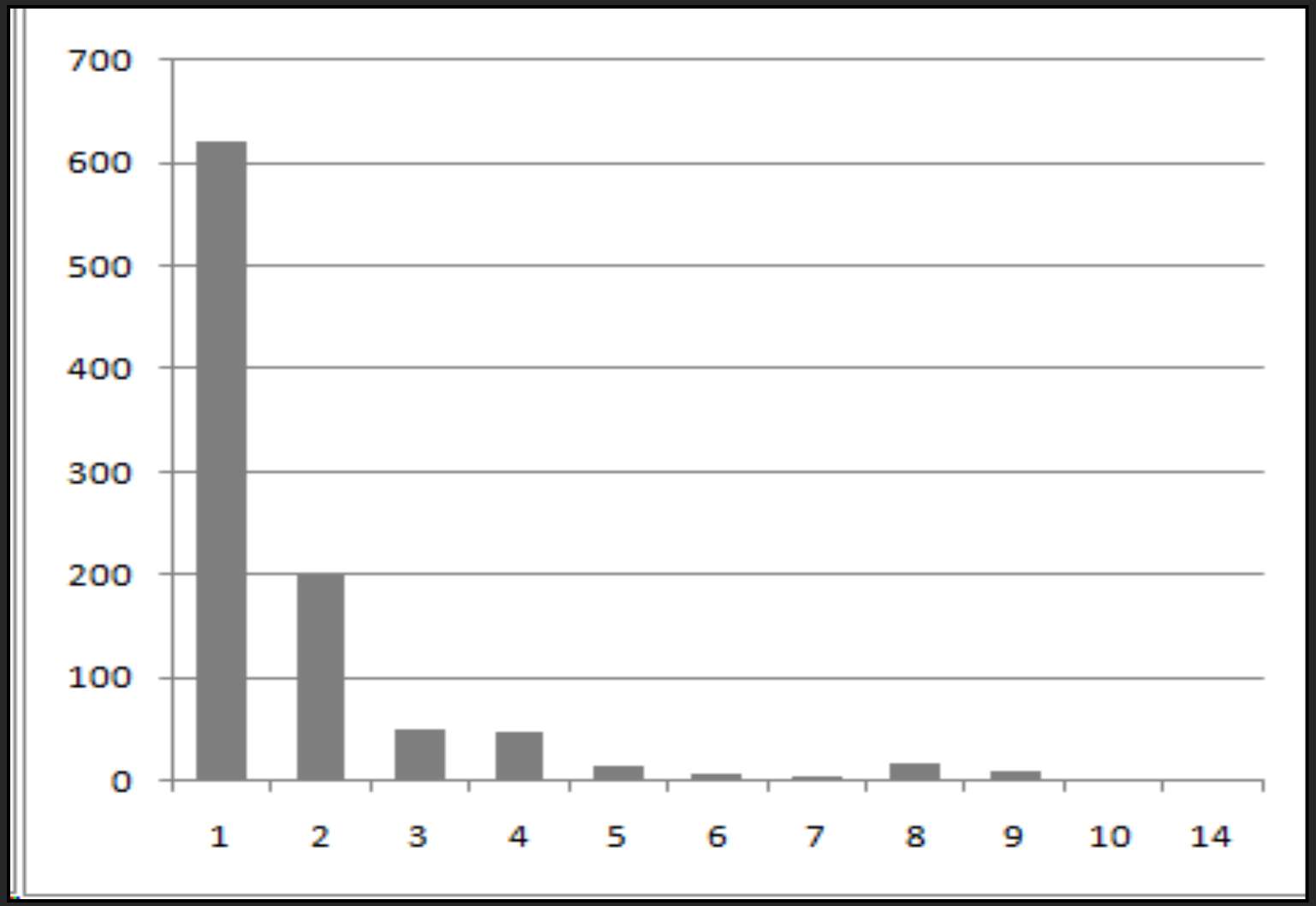
Study Population

- 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

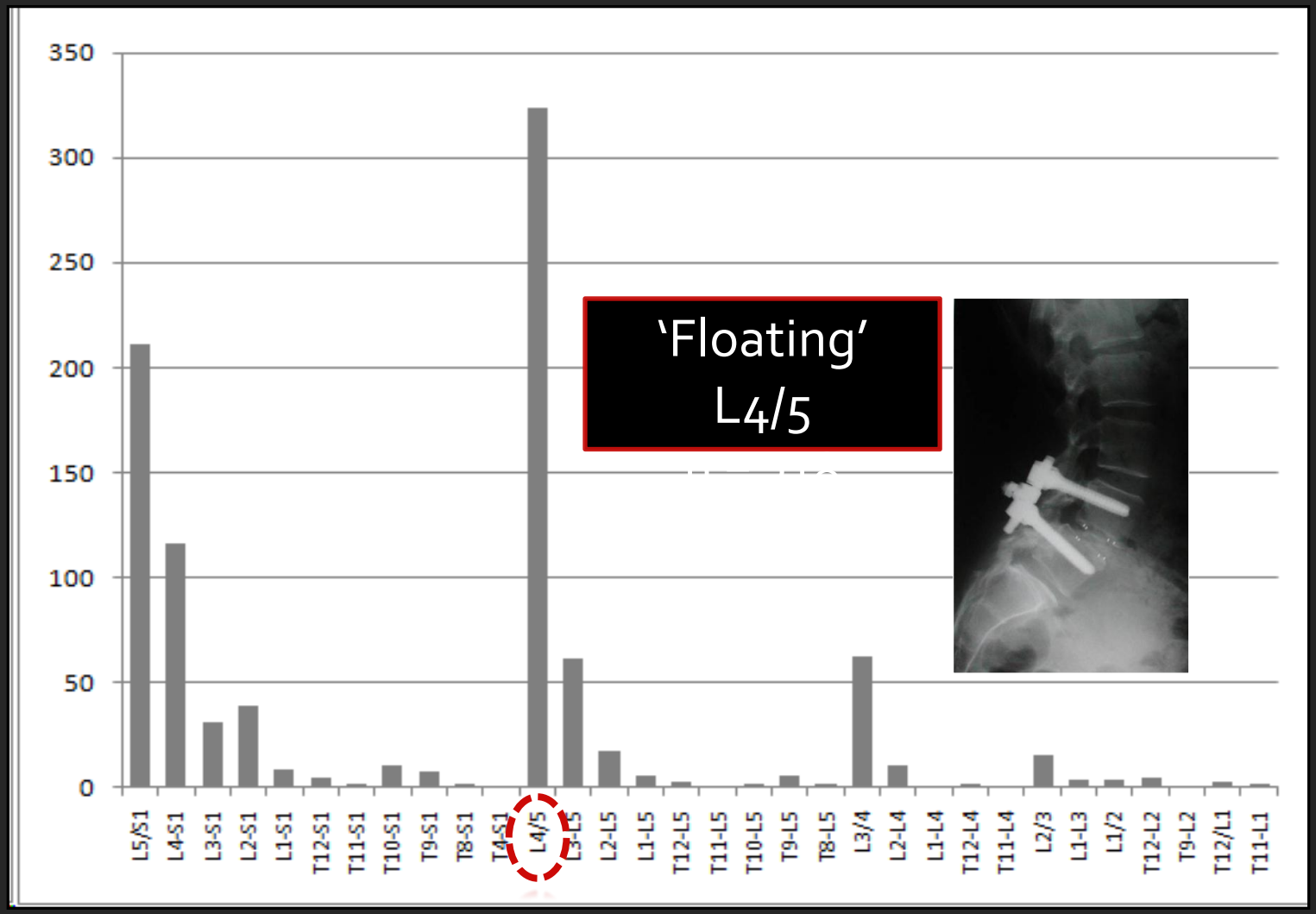
Surgical Technique

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

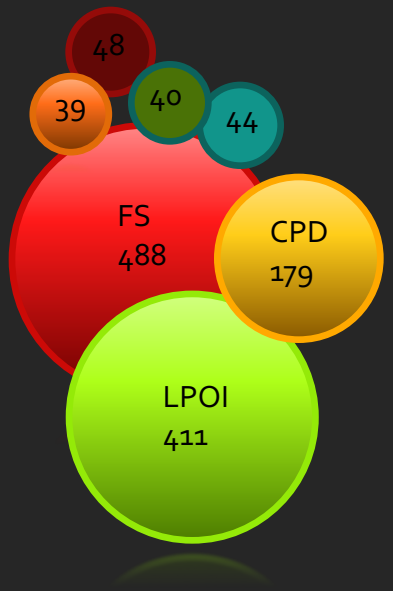
Numbers of Levels fused



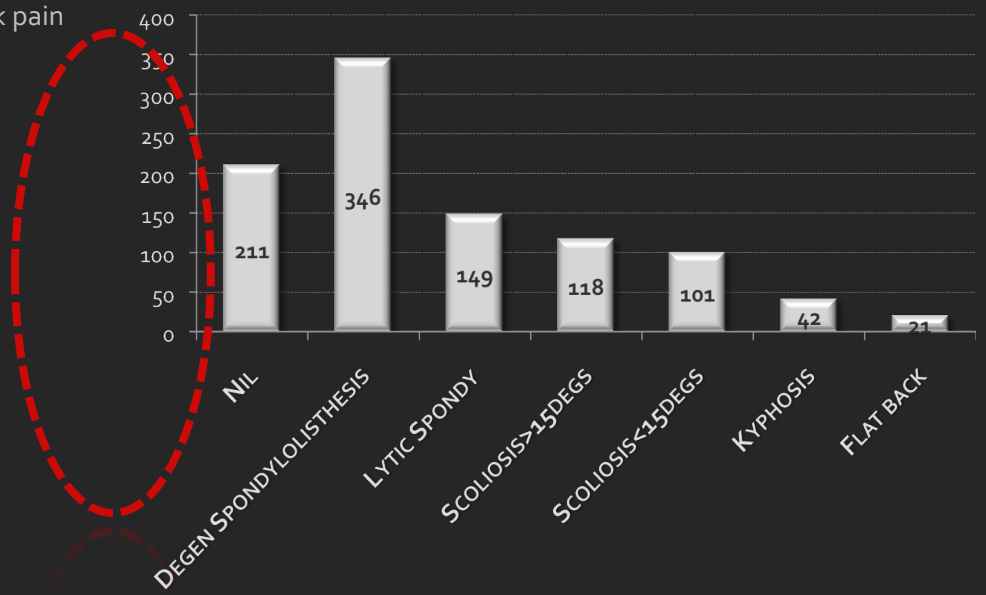
Levels fused



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

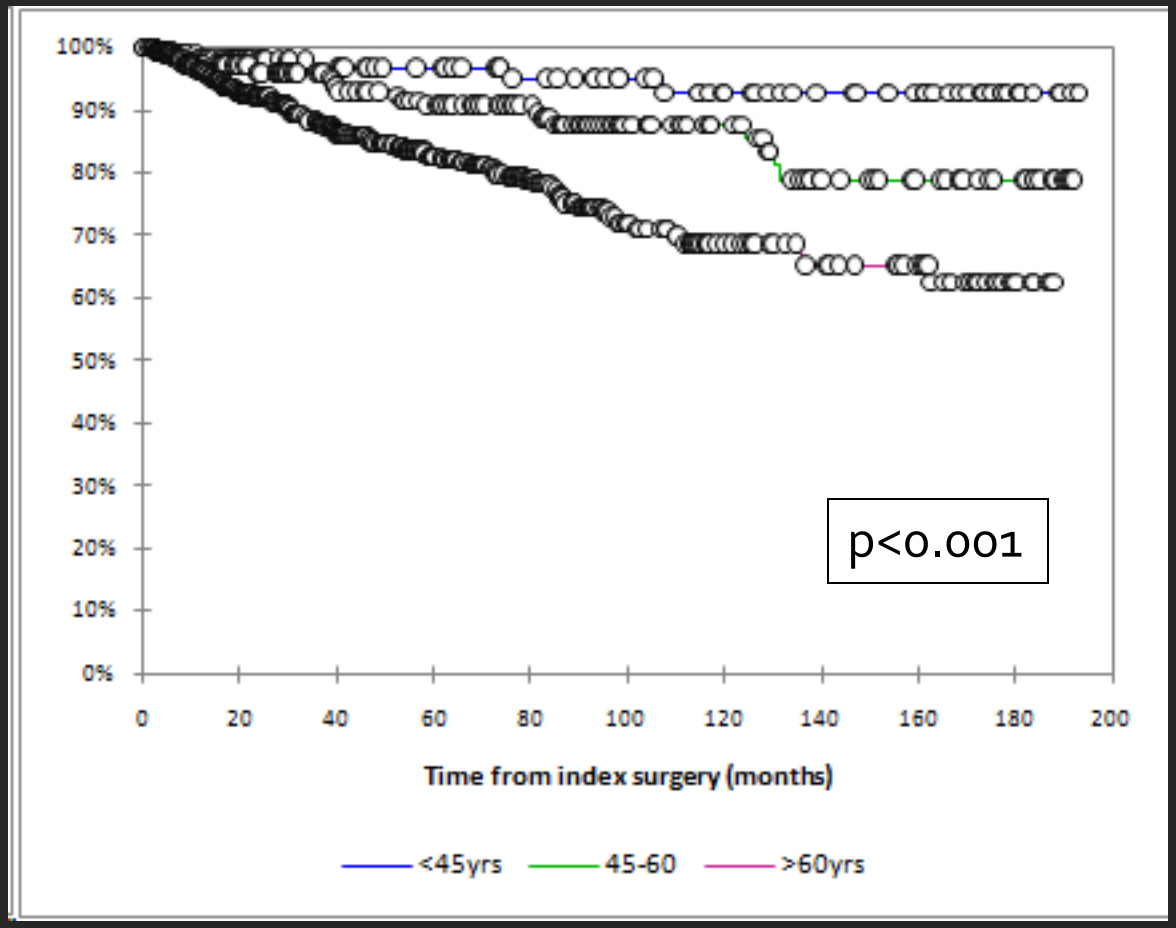
- Xlstat version 2009.6.03 & Medcalc version 11.2.1.0
- Significance set at $p < 0.05$

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)

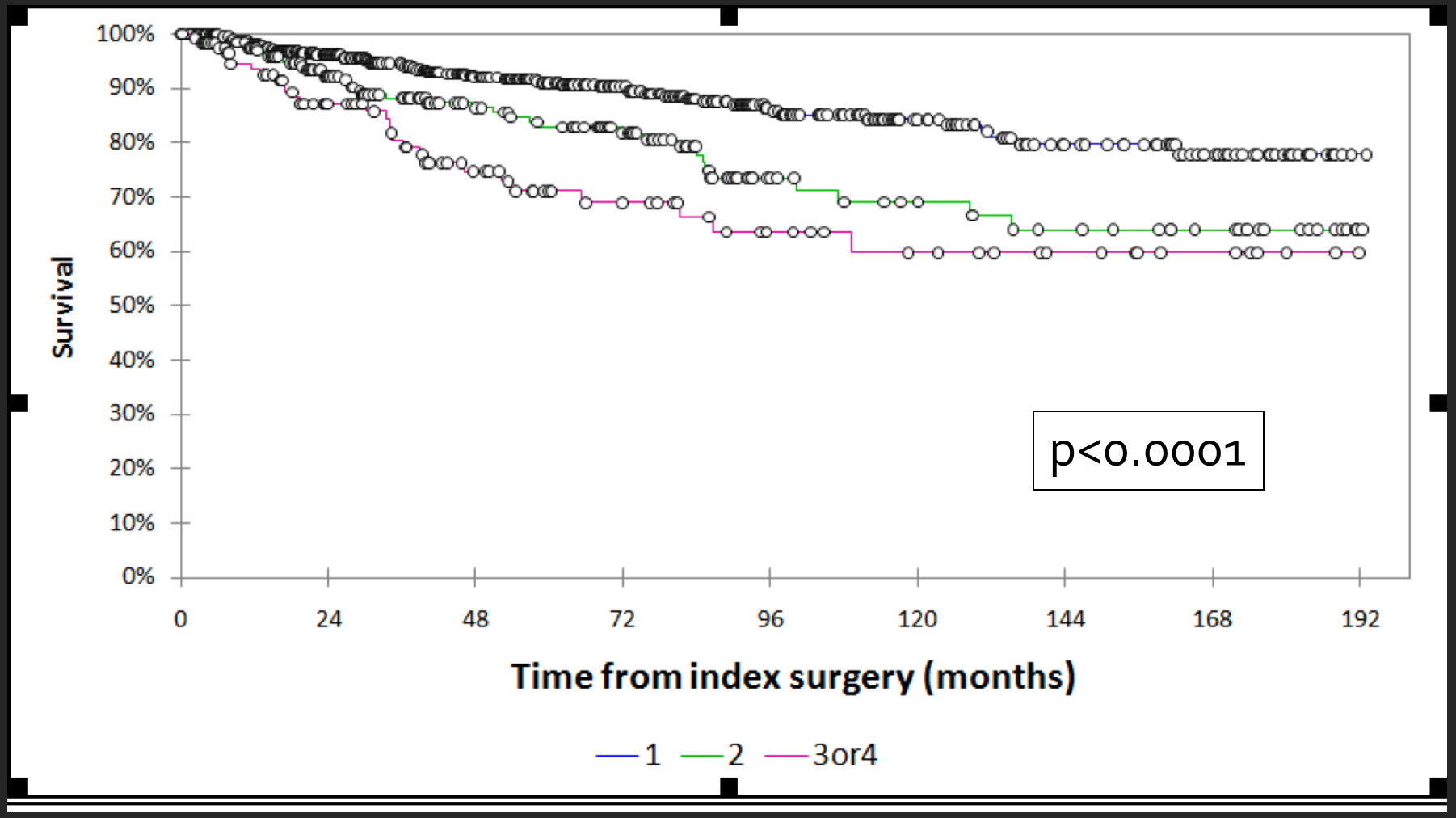
Kaplan Meier Survivorship Analysis

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



Kaplan Meier Survivorship Analysis

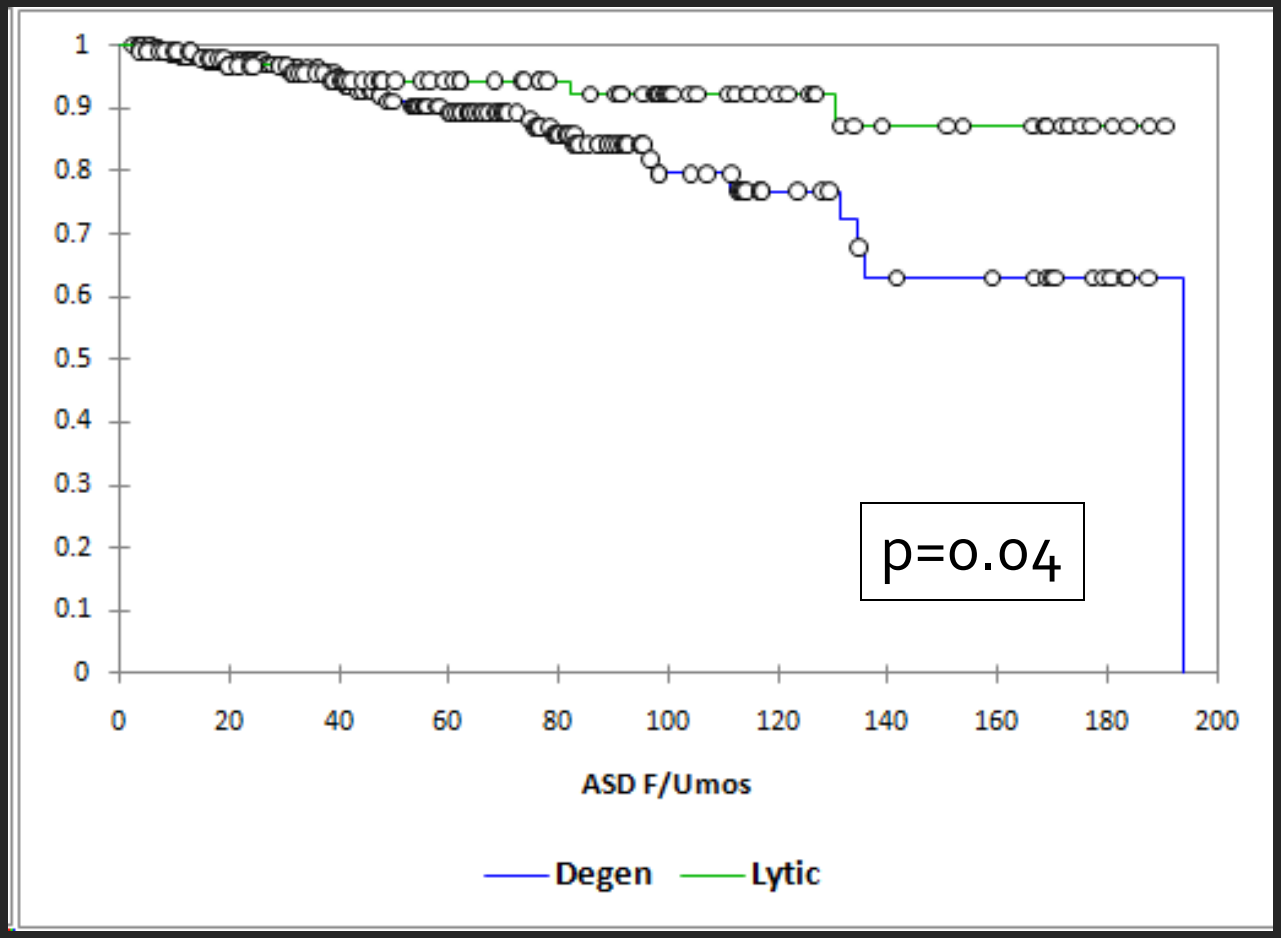
Number of Levels Fused: *1, 2, 3 & 4*



Annual Incidence & Prevalence *vs.* Number of Levels Fused

No. of Levels Fused	**Annual Incidence** **(95%CI)**	**Prevalence** ***5 year***	**Prevalence** ***10 year***
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 = L5	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)

Conclusions

- ASD incidence 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 %)
  - Age *(p<0.001)*
    - especially < 45 years – risk: x 0.25 (cf. 60+yrs)
- Take care when interpreting ASD rates - especially following singe level surgery in young patients – e.g. in US IDE disc prosthesis studies