Long term outcomes of EOS fusions
Average 34 years since surgery

John E Lonstein

Clinical Professor, Dept Orthopedics, University of Minnesota.

Twin cities Spine Center, Mpls.

Gillette Children's Specialty Healthcare, St. Paul

Supported in part by a SRS Research Grant

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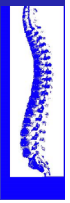
Disclaimers

- Royalties
  - Biomet Spine

Why don't we Fuse early?

- Effects of early fusion on PFT and growth of spine



Respiratory Function and Cosmesis at Maturity in Infantile-onset Scoliosis

- 21/32 patients
- 11 patients fused < age 10
  - Mean age at surgery 4.1 (1.4-7.8)
  - Mean age at follow-up 16.6 yrs. (12.6-23.9)
- Mean FVC 40.8% predicted (12-67%)

Goldberg CJ et al
Spine 28:2397, 2003

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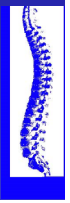

Pulmonary Function Following Early Thoracic Fusion in Non-Neuromuscular Scoliosis

By Lori A. Karol, MD, Charles Johnston, MD, Kiril Mladenov, MD, Peter Schochet, MD, Patricia Walters, RRT-NPS, and Richard H. Browne, PhD

- 28/54 patients
  - Congenital scoliosis 20
  - Idiopathic 3
  - NFT 3
  - Congenital kyphosis 1
  - Syndromic 1
- Average 59% thoracic spine fused
- Average age at surgery 3.3 yrs.
- Average age at follow-up 14.6 yrs. (7.3-17.8)
- Average follow-up 11.3 years

JBJS 90A:1272, 2008

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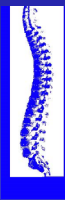

Results

- FVC average 57.8% predicted normal
- Inverse relationship to extent of thoracic fusion
- 16/20 had thoracic height <18cm
- Shorter the thoracic spine, smaller the FVC
- Correlation between proximal level of fusion and decreased FVC

Karol LA et al JBJS
90A:1272, 2008

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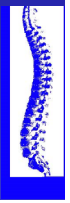
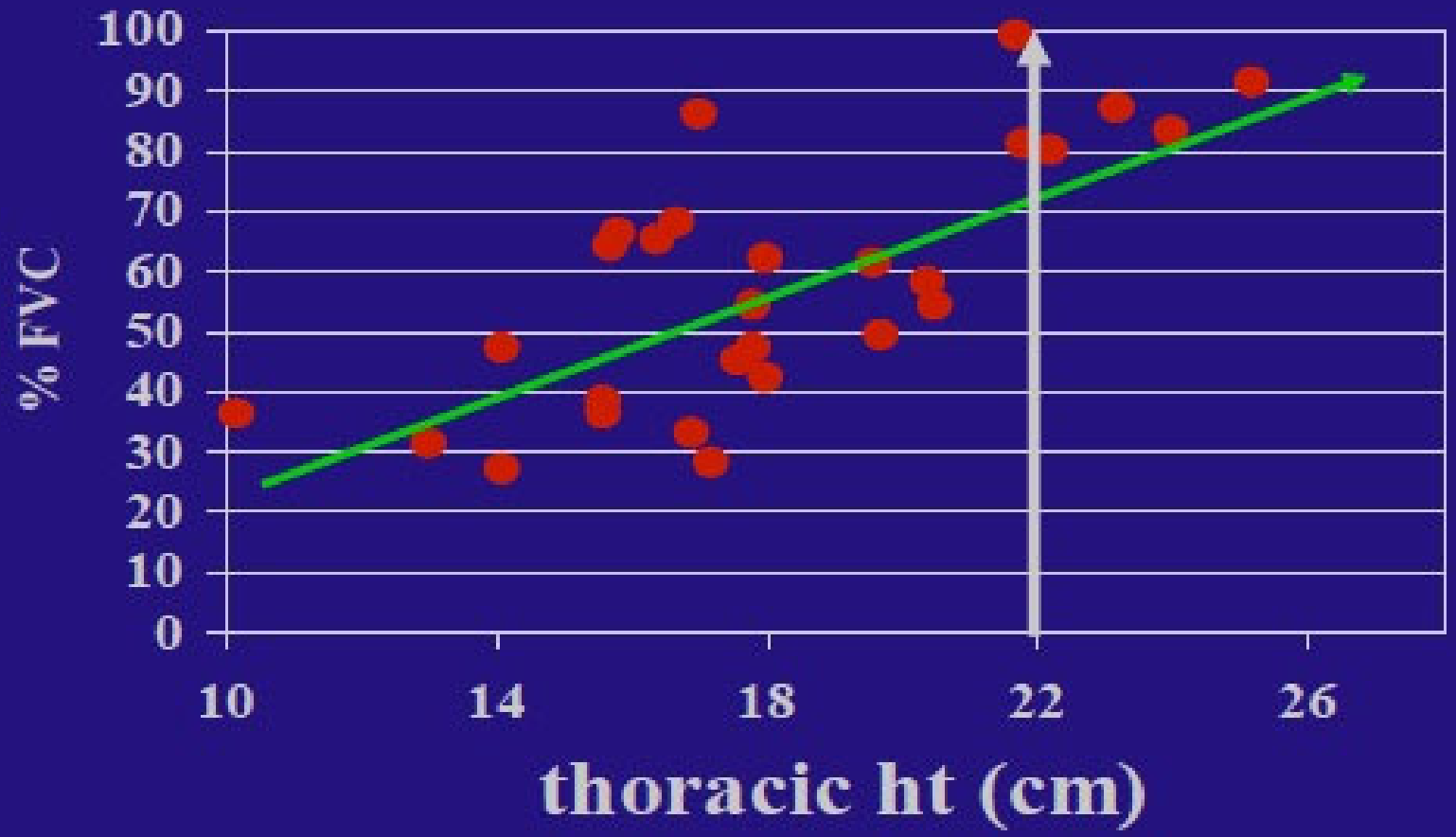


FVC VS. THORACIC HEIGHT



(r=0.73, p<0.001)

A Retrospective Cohort Study of Pulmonary Function Radiographic Measures, and Quality of Life in Children With Congenital Scoliosis

- 21/62 patients
- Mean of 5.1 levels fused
- 12 thoracic fusions
- Mean age at surgery 4.9 yrs.
- Mean age at follow-up 12.6 yrs. (7-19)

Vitale MG et al
Spine 33:1242, 2008

Results

- FVC mean 74% predicted
- Thoracic fusions mean of 64% predicted

Vitale MG et al
Spine 33:1242, 2008

PFT in Congenital Scoliosis

- 43 patients
  - 30 NS (No surgery)
    - Av. curve 52°
    - Age at presentation 5.6 yrs.
    - Age at f/u 10.8 yrs. (5.2 yrs. f/u)
  - 13 ES (Early surgery)
    - Av. Curve 80°
    - Age at presentation 2.9 yrs.
    - Age at f/u 9.7 yrs. (6.8 yrs. f/u)

Bowen RE et al, Ped Orthop, 5:506 2008

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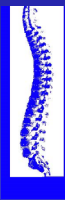

PFT in Congenital Scoliosis

- Restrictive lung disease
  - NS – 69% FVC
  - ES – 67% FVC
- ↓ FVC correlated with
  - Decreased SAL
  - Higher thoracic apex
  - Decreased normalized thoracic width
- In ES group trend to ↓ FVC with
  - Longer follow-up
  - Longer fusion

Bowen RE et al, Ped Orthop, 5:506 2008

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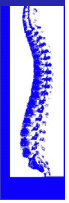
- All short follow-up
- What happens in adulthood with longer follow-up?



Long term F/U study

- Inclusion criteria
  - EOS scoliosis (Congenital or syndromic)
  - Fusion < age 8 years
  - 5+ thoracic levels fused
  - Current age > 20 years

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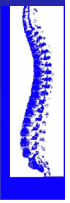
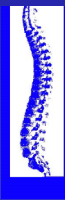


Study

- Retrospective chart and x-ray review
- Identify patients
- Trace patients
- Follow-up
  - X-ray
  - Questionnaire
  - PFT with blood gases



- 52 patients met criteria
- 23 traced
- 21 agreed to participate
- 12 complete data

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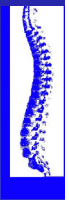
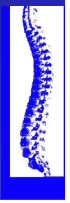


Diagnoses

- 7 males
- 5 females

- 10 Congenital scoliosis
- 1 Diastrophic dysplasia
- 1 Camptomelic dwarfism



Congenital Scoliosis

- Vert. anomalies
  - 8 HV
    - 4 with an unsegmented bar
  - 2 unsegmented bar
- 8 fused ribs
  - 6 with an unsegmented bar
- Other
  - 3 Klippel-Feil
  - 2 diastematomyelia

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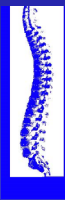
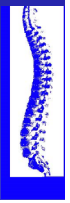


Average Age

- At presentation 1.3 (0-4.2)
- At surgery 5.1 (1.2-7.8)
- At end of growth 17.3 (15-24)
- At follow-up 39.2 (22.7-59.8)
- Surgery to F/U 34.1 (15.6-54.4)



Scoliosis

- Presentation 52° (1.3 yrs.)
- Pre-op 54° (4.5 yrs.)
- 2 yr. Post-op 44° (6.2 yrs.)
- 5 yr. Post-op 37° (10.0)
- EOG 46° (17.6 yrs.)
- Follow-up 50° (39.2 yrs.)

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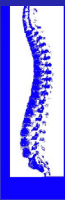
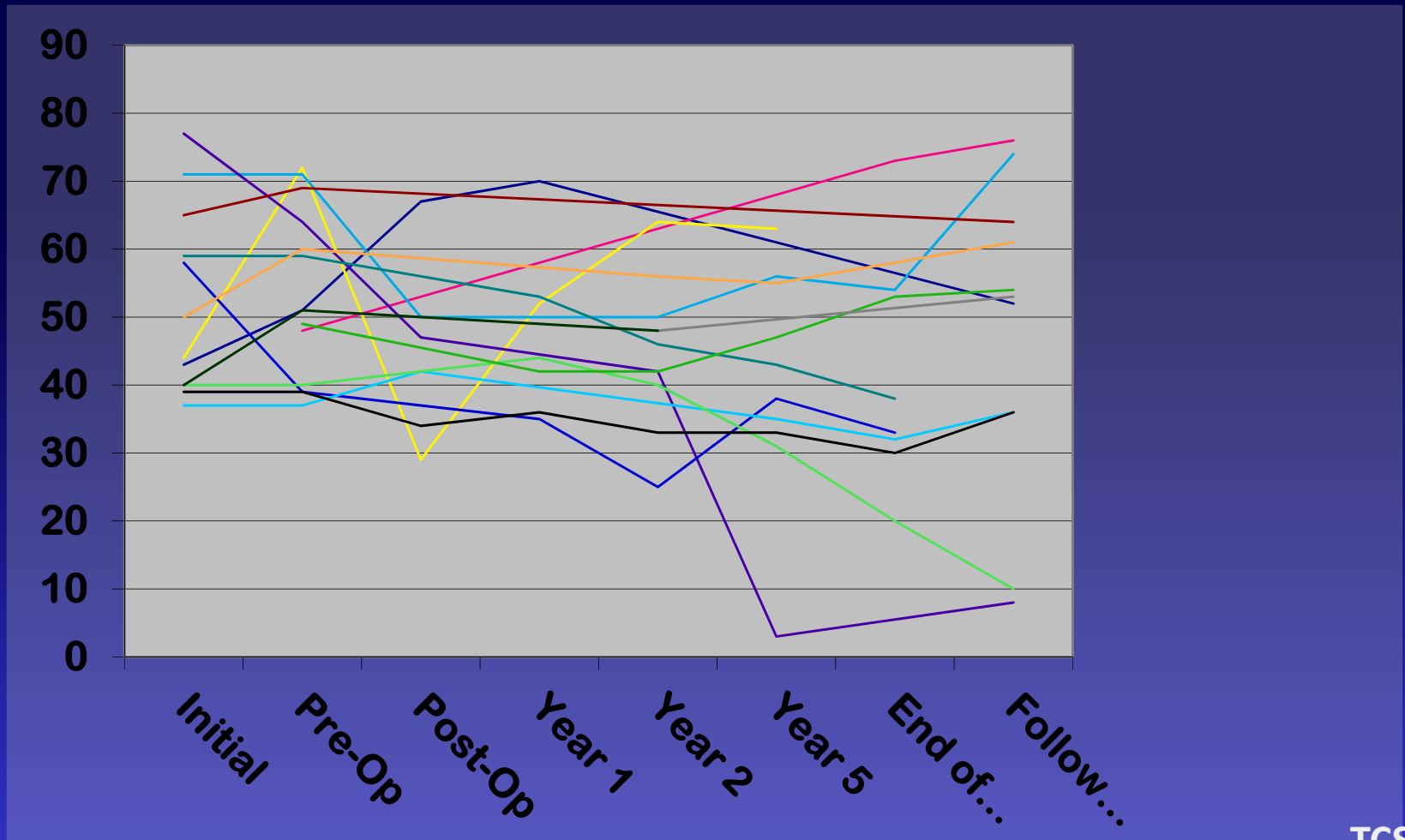


Curve


90
80
70
60
50
40
30
20
10
0
Initial
Pre-Op
Post-Op
Year 1
Year 2
Year 5
End of...
Follow...

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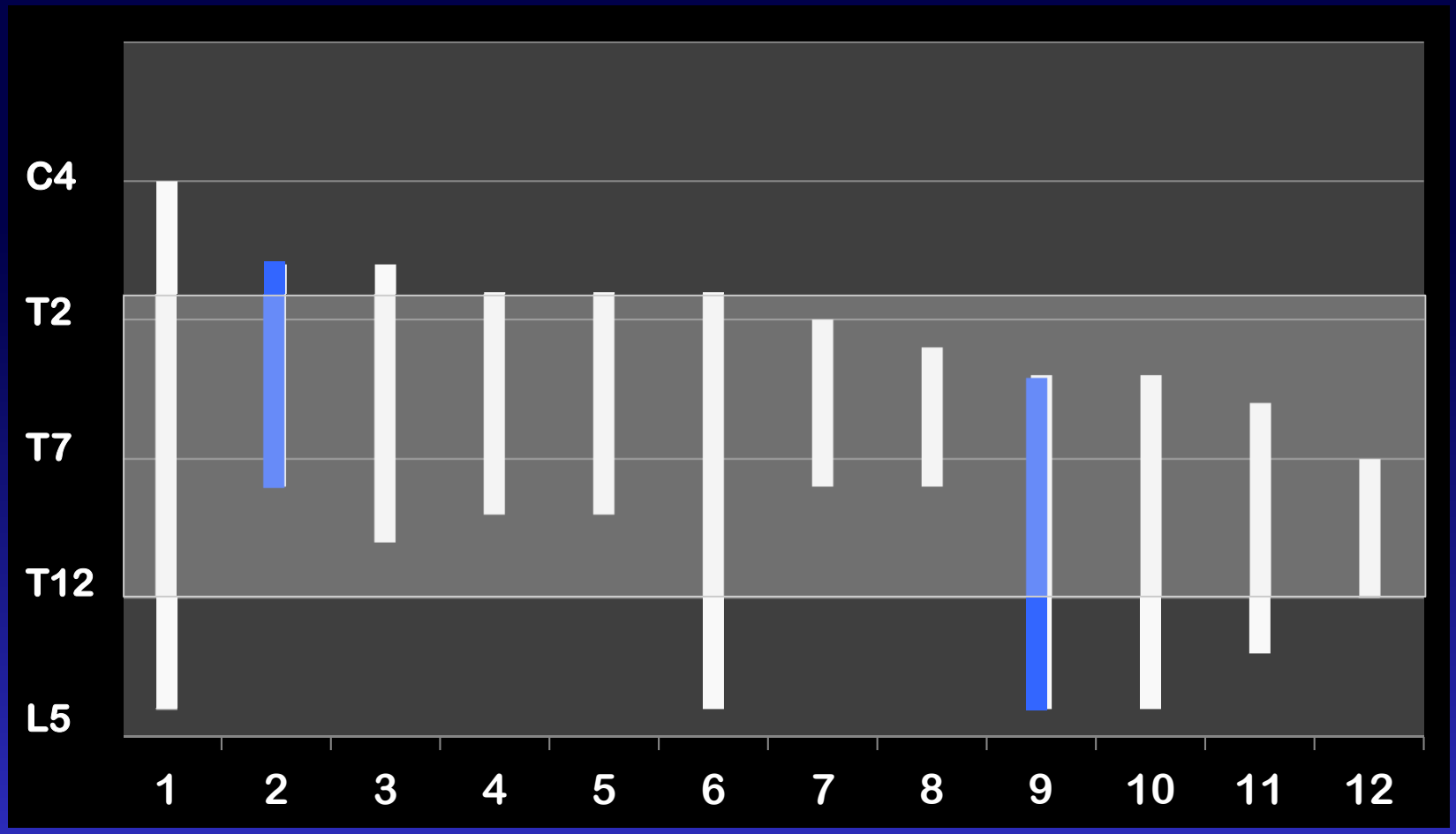
Fusion Extent



Average 10 levels fused

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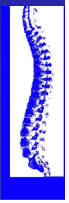
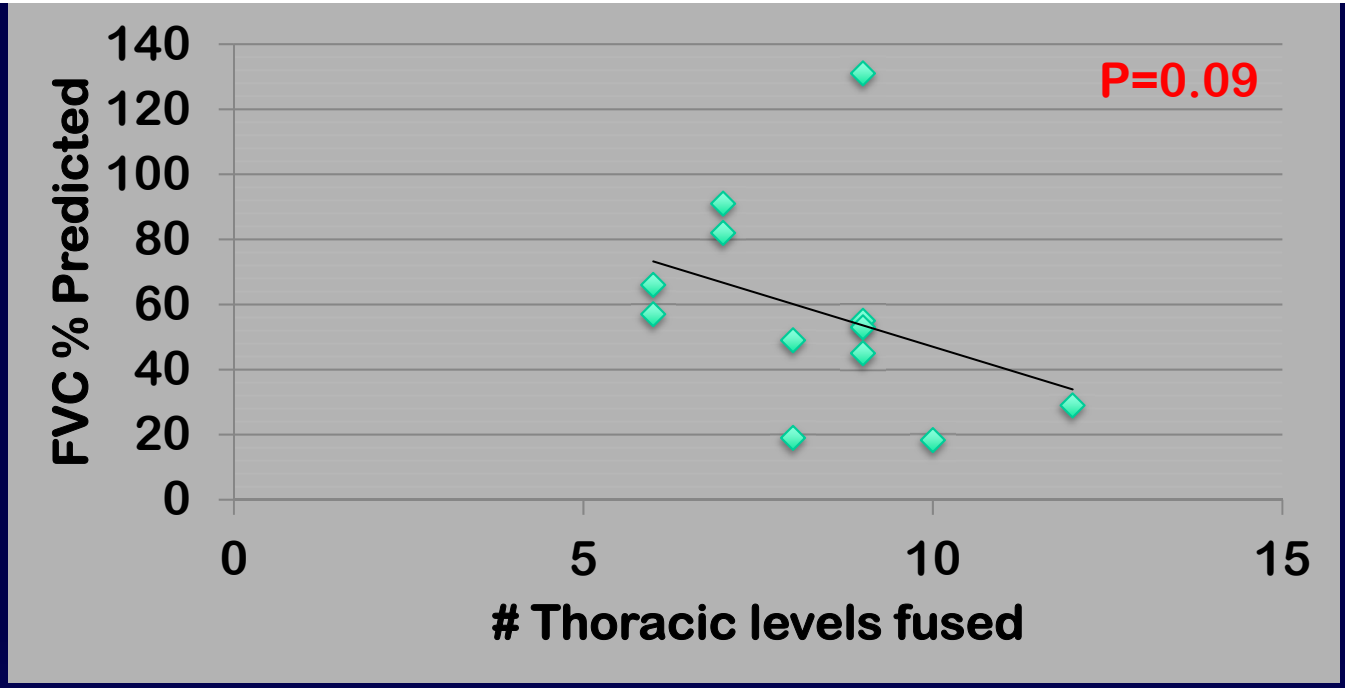
PFT

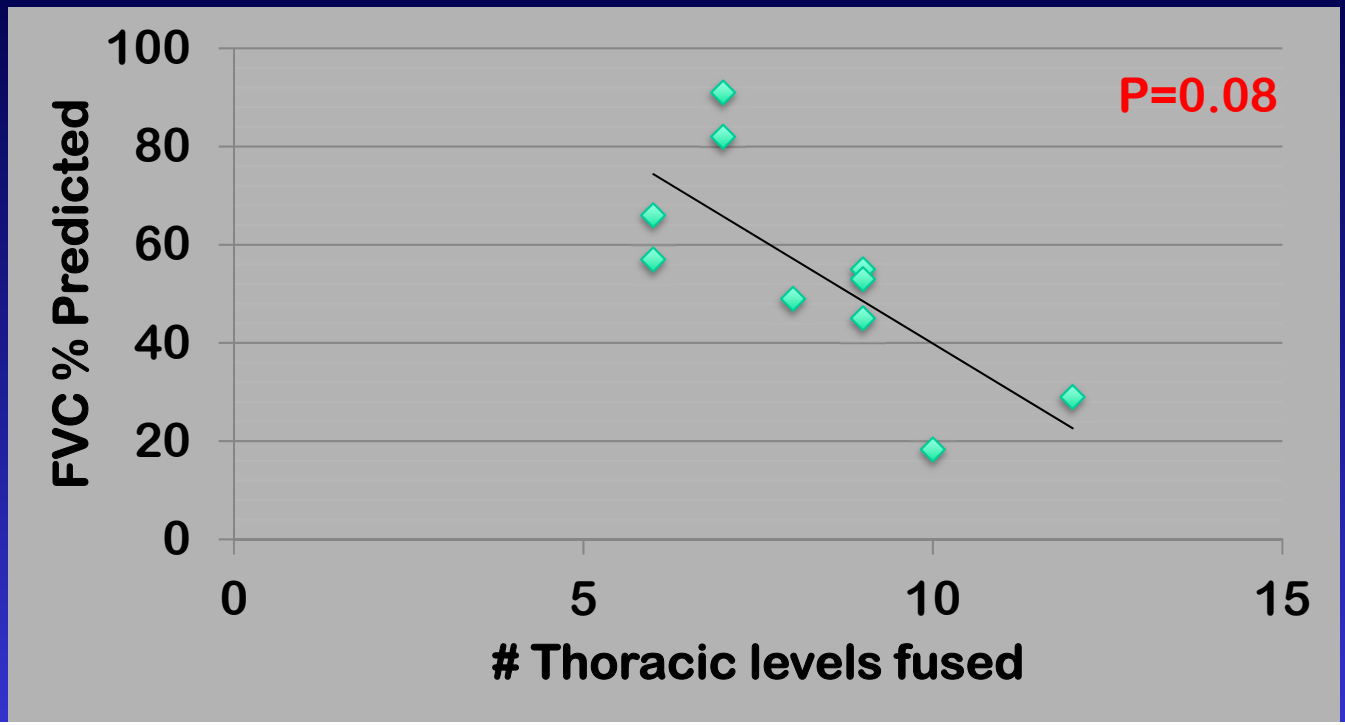
- FVC average 58% predicted (18-131%)
  - $Pa0_2$ average 87mmHg (63-114)
  - $PaCo_2$ average 42 mmHg (35-76)
- 1 permanent 0_2 and BiPap
  - Congenital
  - FVC 18%, PaO_2 63, $PaCo_2$ 76
- 1 CPap for sleep apnea
  - FVC 49%, PaO_2 69, $PaCo_2$ 40



All

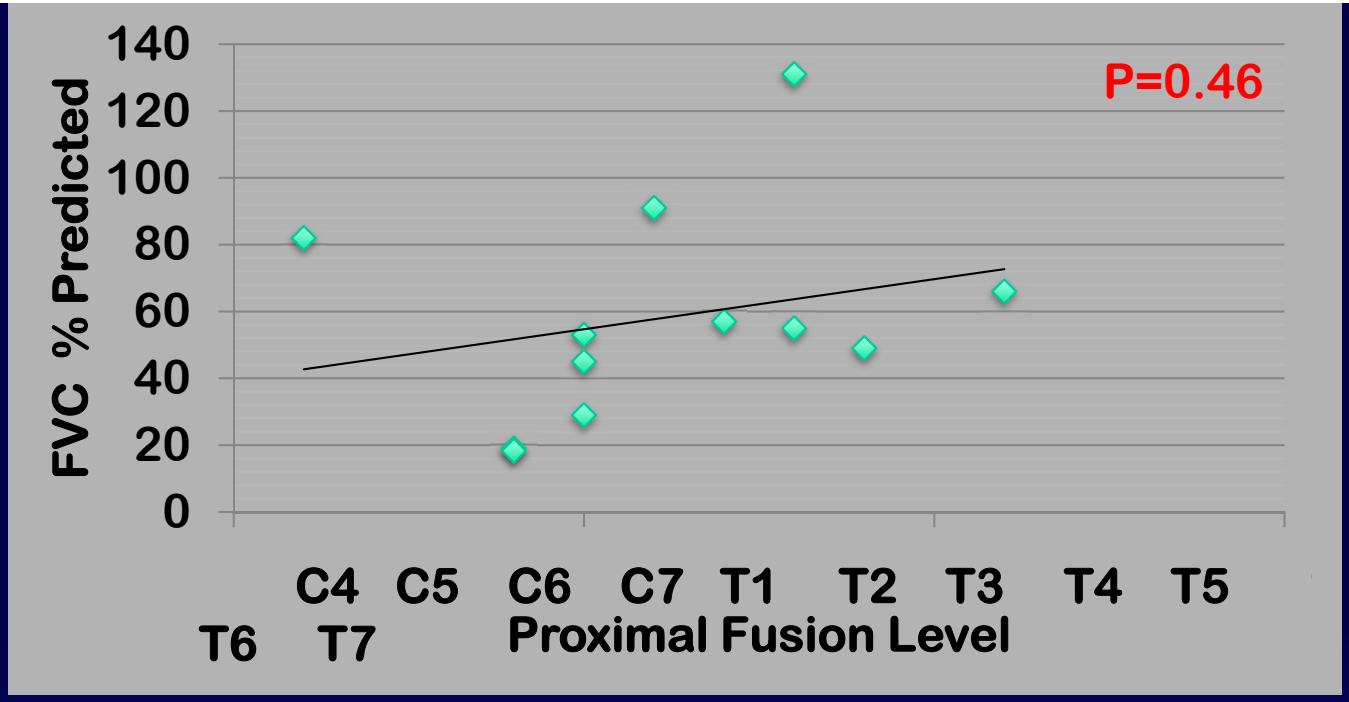


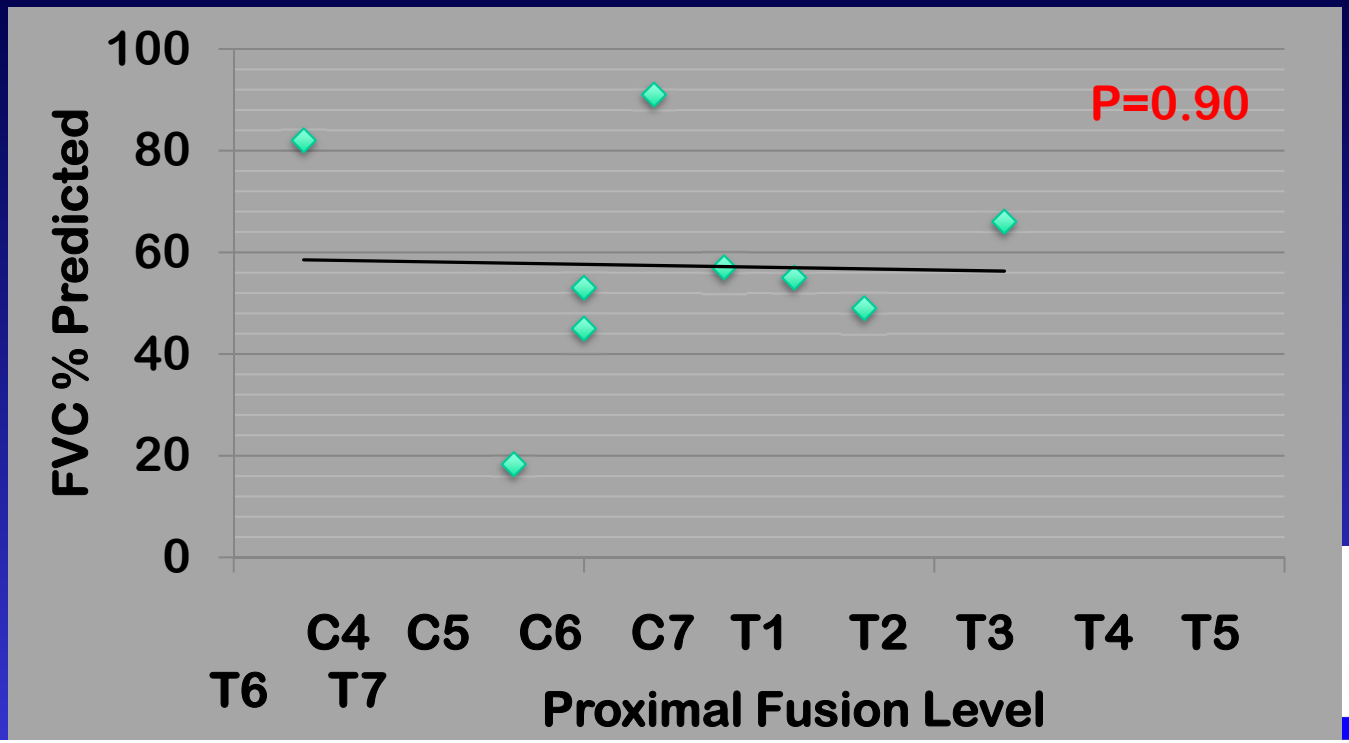
Congenitals



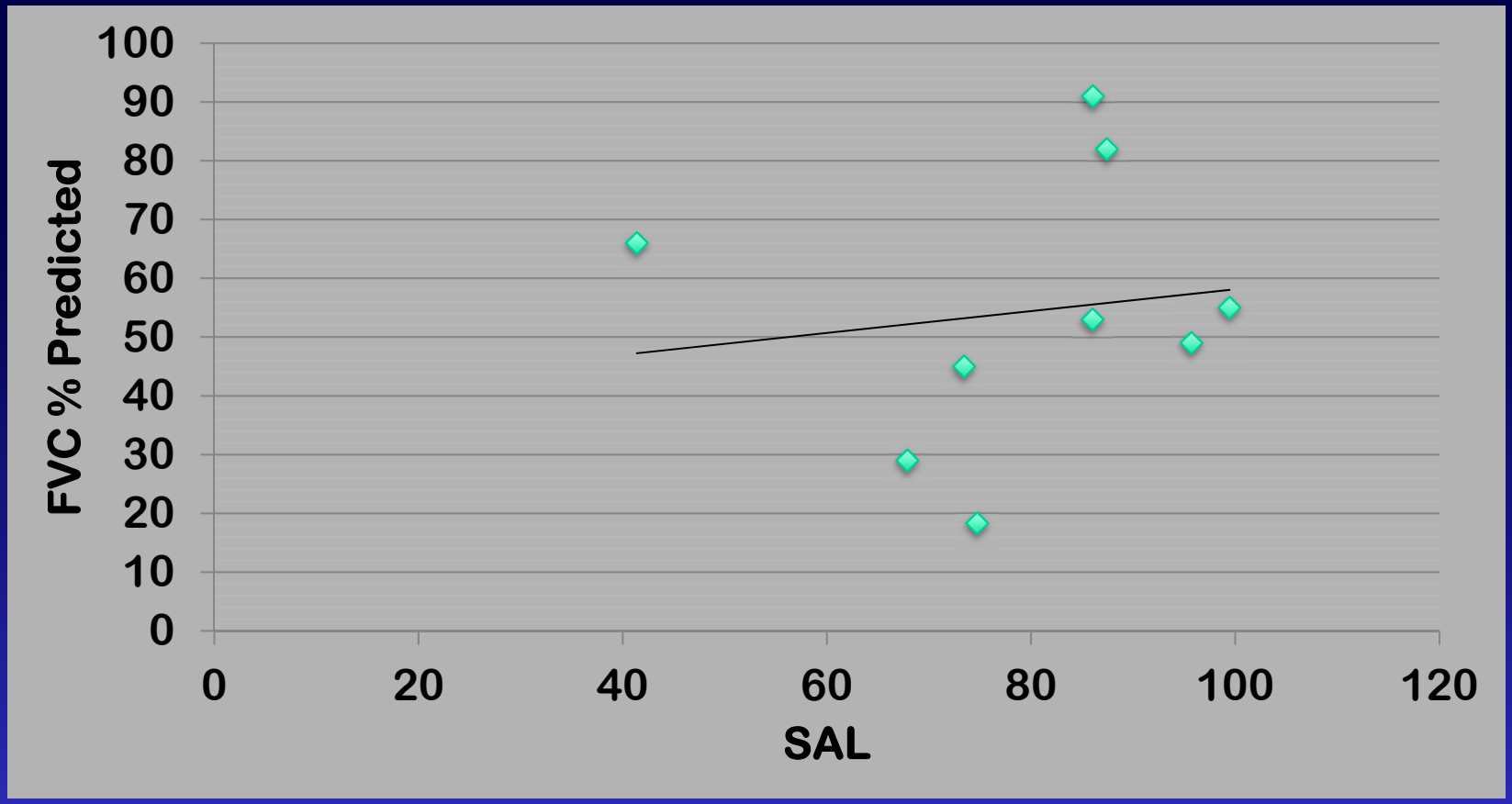
All

Congenital

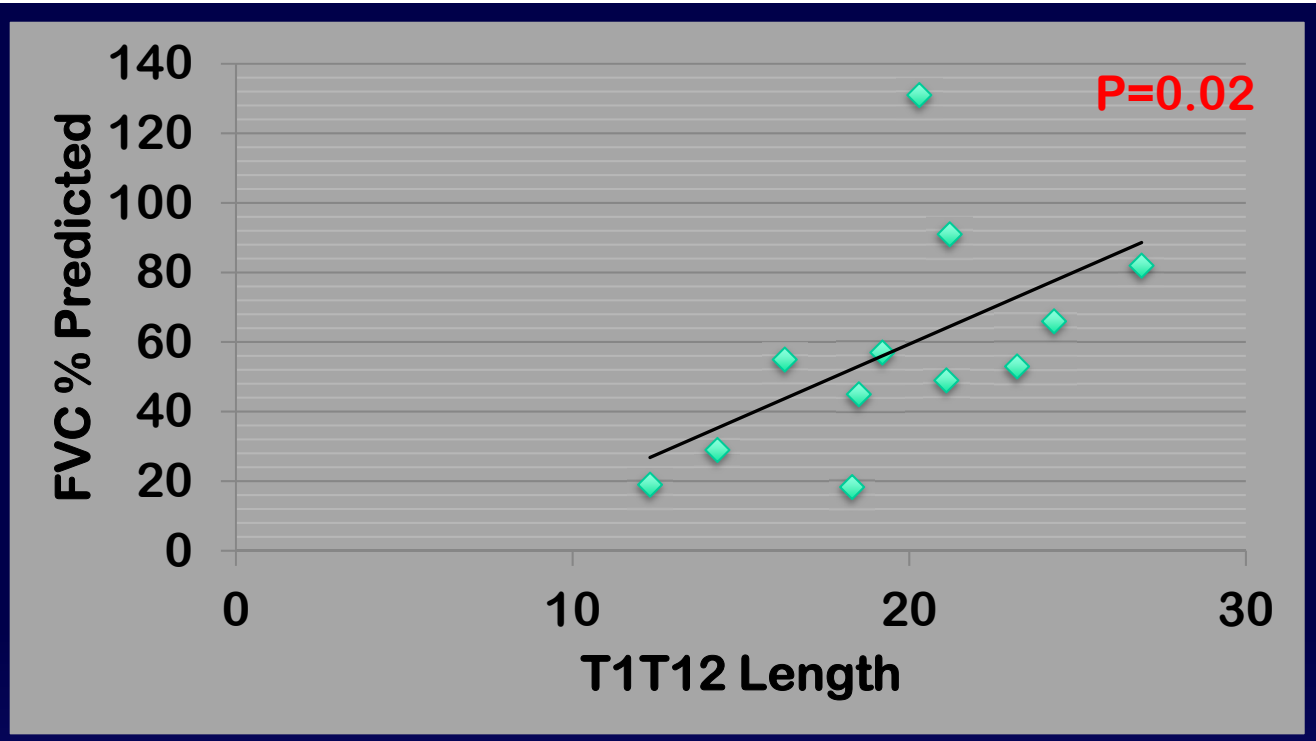




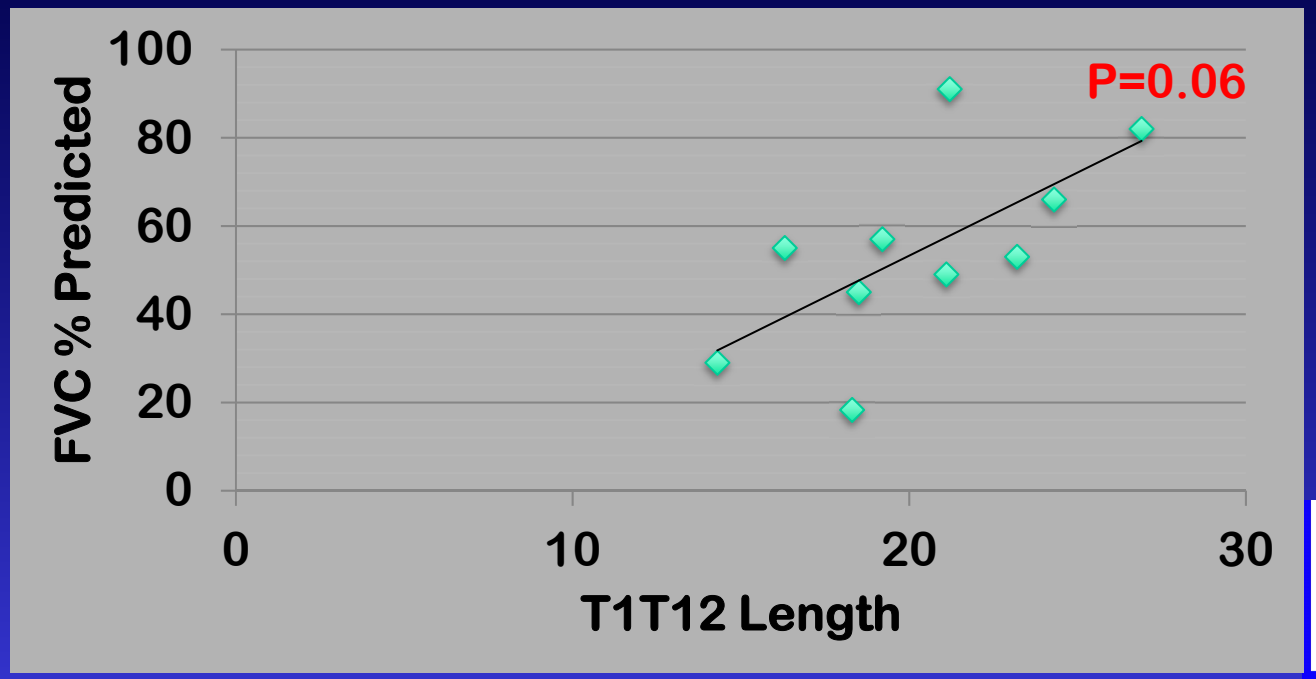
Congenitals



All

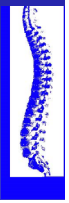


Congenital



T1-T12

- Dimeglio & Bonnel, 1990
  - Normal thoracic height by age
    - Newborn 11 cm
    - 5 yo 18 cm
    - 10 yo 22 cm
    - Adult Female 26.5 cm
    - Adult Male 28 cm



T1T12 height
Congenitals in study

- Average 20.3 cm. (14.4-26.9)
- 4 Females
  - Average 18.8 cm. (16.3-21.2)
  - DiMeglio 26.5 cm.
- 6 males
  - Average 21.4 cm. (14.4-26.9)
  - DiMeglio 28 cm.

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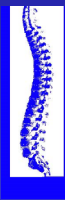

Height of Patients at the Visit Closest to Their 16th Birthday Versus 3rd , 50th , and 97th Centiles for Age

Congenitals -38 Boys
Av Age (yrs.) 16.4
Mean height (cm) 161.89

Normals 97th centile (cm) 184.7
50th centile (cm) 171.5
3rd centile (cm) 158.3

Congenitals -79 Girls
Av Age (yrs.)16.8
Mean height (cm) 151.79

Normals 97th centile (cm) 173.5
50th centile (cm) 162.6
3rd centile (cm) 151.7

Goldberg CJ et al
Spine 27:1191,2002

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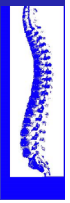
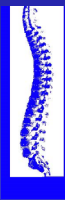
Congenital T1T12 Height Female

- Standing height 152 cm. (Goldberg)
- Sitting height 76 cm. (50%)
- T1S1 38 cm. (50%)
- T1T12 22.8 cm. (60%)
  - Study (4 pts) 18.8 (16.3-21.2)
  - Normal 26.5 cm. (Dimeglio)



Congenital T1T12 Height Male

- Standing height 158 cm. (Goldberg)
- Sitting height 79 cm. (50%)
- T1S1 39.5 cm. (50%)
- T1T12 23.7 cm. (60%)
  - Study (6 pts) 21.4 (14.4-26.9)
  - Normal 28 cm. (Dimeglio)



Questionnaire

- Employment
  - 4 Full time
  - 1 Part time
  - 2 each homemaker, student
  - 2 Disability

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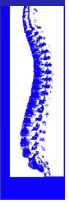
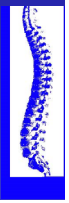


Questionnaire

- Respiratory
  - Dyspnea
    - 4 yes, 8 no
    - 4 with stairs, 8 no
    - 3 ADL, 9 no



Oswestry

- Average 8%
  - 7- 0%
  - 2 – incomplete
  - 10, 34 & 46%

SF-36

- 4 domains low values
  - Physical component 48 (27-60)
  - Mental component 53 (34-66)
  - General health 66 (5-100)
  - Vitality 62 (20-90)

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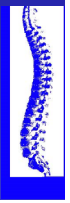
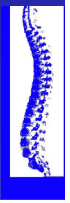


Summary

- At average age of 39, 34 yr. F/U
  - T1T12 height shortened compared to congenitals
    - 2.3 cm in males
    - 4 cm in females



Summary

	Diagnosis	# Patients	Av. Age at F/U (yrs.)	FVC%
Goldberg (2003)	Idiopathic	11 fused <age10	16.6	40.8%
Karol (2008)	Mixed	28 (20 cong.)	14.6	57.8%
Vitale (2008)	Congenital	21 (12 thor.)	12.6	64%
Bowen (2008)	Congenital (NS)	30	10.8	69%
	Congenital (ES)	13	9.7	67%
Lonstein (2013)	Mixed	12 (10 cong.)	39.2	58%

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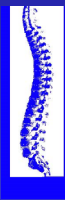

Summary

- FVC 58% predicted
  - 1 on permanent oxygen
  - 4/12 dyspnea
- ↓ FVC not correlated with
  - Extent of thoracic fusion
  - Proximal level fused
  - T1T12 length
  - SAL
- Restrictive lung disease in non fused congenital scoliosis

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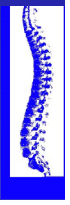

Summary

- Function well
  - Work
  - Back pain – Oswestry av. 8%
- SF-36
  - Wide range
  - Low physical and mental components
  - Slightly low general health and vitality scores

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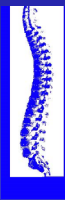

Problems with studies

- Small numbers
- Follow-up
  - Selection bias due to small numbers
- Mixes diagnoses
- Do not know “Normal” values for
  - IIS, JIS
  - Congenital
  - Syndromes

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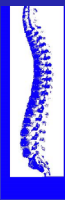

Thank You