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Sagittal Alignment and Correction: Has the Pendulum Swung to Far

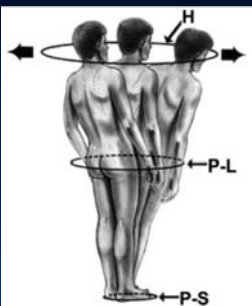
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Normal Balance

- The Cone of Economy
- Balance & Horizontal Gaze with Minimal Muscle Action



Life is a Kyphosing Event!

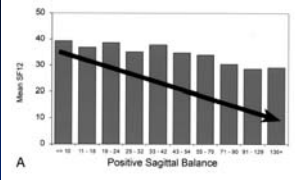
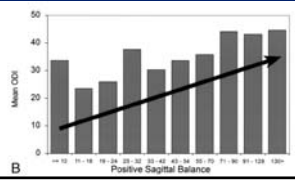
- Thoracic Kyphosis → Increases
- Lumbar Lordosis → Decreases
- Pelvis: PT increases and SS decreases




Adult Deformity

- As sagittal balance increases
- Clear decrease in SF-12
- Clear increase in ODI

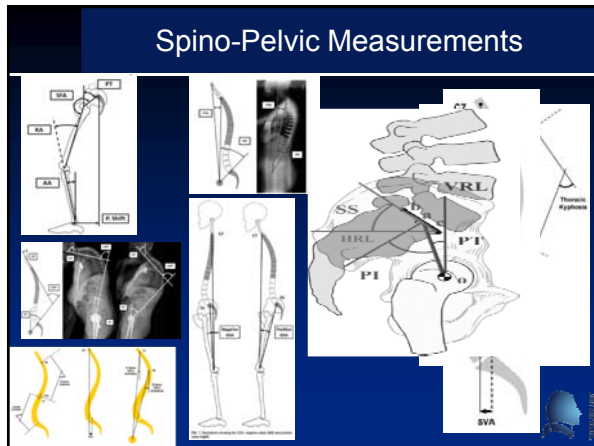
Glassman, Spine 2005; Daubs, Spine. 2013







Adult Deformity


- Schwabb, Spine. 2013
 - 492 consecutive pts, adult spinal deformity
 - Threshold radiographic spinopelvic parameters for ODI more than 40 to be:
 - PT 22° or more ($r = 0.38$),
 - SVA 47 mm or more ($r = 0.47$)
 - PI - LL 11° or more ($r = 0.45$)





Adult Deformity

- Do all patients undergoing spinal surgery with sagittal imbalance need a large deformity surgery?
- Is the literature relevant to all (or even most) patients



Adult Deformity

Yoshida. Spine. 2014

- 671 asymptomatic patients
 - Mean age 72
 - Average C7-SVA
 - Men 4.81cm
 - Women 4.88cm
- **The average asymptomatic 72 year old is within 0.12 – 0.19 cm of having a “Deformity”**

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Adult Deformity

- Scheer, AANS 2015
- 833 patients

Age group	Number	PT (deg)	PI-LL (deg)	SVA (cm)
≤45	218	15.3 ± 2.3	1.7 ± 3.5	3.3 ± 1.2
46-64	381	22.6 ± 1.5	12.5 ± 2.2	7.1 ± 0.8
65-74	172	26.2 ± 0.8	18 ± 1.2	9.0 ± 0.4
≥75	62	29.1 ± 0.8	22.4 ± 1.3	10.5 ± 0.4

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Adult Deformity

- Literature not appropriate for older patients

Table 1. Normative Radiographic Spinopelvic Values

Parameter	Normative Values and References					
	Schwab et al. 2005 ¹	Berthonnaud et al. 2005 ²	Vialle et al. 2002 ³	Legaye et al. 1998 ⁴	Boulay et al. 2006 ⁵	Roussouly 2006 ⁶
Age	49.3 yr (18-80)	25.7 ± 5.5 yr (20-70)	35 yr (20-70)	34.0 ± 5.8 yr (19-50)	30.8 ± 6.0 yr (19-50)	27 yr (18-48)
SVA	-20 ± 20	—	-1.4 ± 2.7 (-9.2-7.1)	—	—	25.2 ± 18.4 (-18.1-60.8)
T1-SPI	—	—	—	—	—	—
TK (T4-T12)	41 ± 12	47.5 ± 4.8 (22.5-70.3)	40.6 ± 10.0 (0-89)	-43.0 ± 13.0	53.8 ± 10.1 (33.2-83.5)	46.3 ± 9.5 (23.0-65.9)
LL (L1-S1)	65 ± 13	43.7 ± 5.4 (16-71.9)	60.2 ± 15.3 (20-88)	-40.0 ± 10.0	86.4 ± 9.5 (44.8-97.2)	61.2 ± 9.4 (38.9-82.7)
PI	52 ± 10	51 ± 5.3 (33.7-62.7)	54.7 ± 10.6 (28-82)	-52.8 ± 10.0	53.1 ± 8.0 (33.7-77.5)	50.6 ± 10.2 (27.9-82.8)
PT	15 ± 7	12.3 ± 3.2 (-5.1-28.5)	12.2 ± 6.1 (-4.5-20)	-11.0 ± 5.5	12.6 ± 6.4 (-2-26)	11.1 ± 5.8 (-2.8-22.7)
SS	30 ± 9	30.7 ± 4.1 (21.2-45.9)	41.2 ± 8.4 (17-62)	-40.0 ± 8.5	41.2 ± 7.0 (0.6-78.7)	38.6 ± 7.6 (17.5-63.4)

SVA indicates sagittal vertical axis; T1-SPI, T1 Spinopelvic inclination; TK, thoracic kyphosis; LL, lumbar lordosis; PI, pelvic incidence; PT, pelvic tilt; SS, sacral slope.

- Oldest average age 49.3
- Fails to appreciate natural change in alignment as a patient ages!

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MIS Deformity Surgery

- MIS deformity surgery -ceiling effect in the amount of potential correction
- Can correct SVA to < 50mm if preoperative SVA < 100mm
- Mean Cobb angle correction 61%
- HRQOL long term outcomes good-why need complete correction


Wang, NS Focus, 2014; Anand, NS Focus, 2014

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COMPLICATIONS

- **Trammel. Spine. 91**
80% Patients had a complication
- **McDonald. Spine. 93-Major Complications**

21-40 y/o	6%
41-60 y/o	14%
61-85 y/o	24%




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COMPLICATIONS

Akbarnia, Spine, 06

- Adult deformity cases fused to sacrum
 - 56-75% complication rate
 - 18 – 58% unplanned reoperation rate



Complications ASD surgery Intra-op

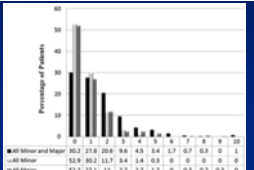
- 9.1% patients experienced intra-op complication
- **Peri-op (within 6wk):**
52.2% of patients experienced peri-op complication.

Use the accompanying material in this issue (2010)


Neurology Focus: N01012-01 (2010)

Complications in adult spinal deformity surgery: an analysis of minimally invasive, hybrid, and open surgical techniques


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Vincent DeVore, M.D., Steve Ross, M.D., and Christopher I. Shuman, M.D., on behalf of the
International Spine Society Group



Number of Complications	All Minor and Major	All Minor	All Major
0	52.2	27.4	20.6
1	34.4	4.5	3.4
2	1.7	0.7	0.3
3	0.3	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0

 **Disclosures**

- Deformity Groups work product-
support complex spinal procedures
that utilize large healthcare dollars
especially expensive implants
- Study groups that study non implant
related spinal diseases-poorly funded
or not at all by industry



 **Disclosures Rarely Discussed**

- International Spine Study Group (ISSG) is funded by
a generous grant from...



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- Similarly, the Harms Study Group is also funded by a
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Pediatric Deformity


- National meeting advice 1998-2008: pedicle screw every level, multiple large kits of BMP
- Between 1996 and 2007 the inflation adjusted cost of treating AIS increased by 100%
 - In the same time the cost of treating a femur fracture increased by 7%



Roach, JPO, 2011

Adult Deformity

- Sciubba (ISSG). ESJ 2015
 - 27 patients > 75 years of age
 - Operative patients more likely to reach MCID (range 41.7-81.8 vs. 0-33.3 %, $p < 0.05$)
 - 75% had at least one complication
 - 50% required revision surgery within 2 years
 - Conclusion: Recommended surgery



Summary

- Use Common Sense and keep eyes wide open
- Many adult patients with sagittal plane deformity do NOT require a large deformity operation
- Do not over treat sagittal malalignment in the elderly

