Adolescent Idiopathic Scoliosis Has High Prevalence of Negative Sagittal Balance: Anteversion of Pelvis Used to Decrease Lumbar Lordosis to Compensate for Loss of Thoracic Kyphosis

J Todd, S Haleem, T Bishop, J Bernard, DF Lui

St George's Healthcare NHS Trust
The Royal Orthopaedic Hospital NHS Foundation Trust
Worcestershire Acute Hospitals NHS Trust

BACKGROUND

Positive sagittal balance is linked to increased pain and reduced ability to maintain horizontal gaze. The impact of negative sagittal balance is less well understood. Adolescent idiopathic scoliosis is known to be hypokyphotic which may drive a negative plumb line. This study intended to compare sagittal vertical axis (SVA) to various spinal and pelvic parameters to investigate the possible proportional relationship between increased thoracic lordosis and negative SVA.

METHODS

We retrospectively reviewed 116 patients first presenting with AIS from 2015 to 2016. For patients with negative SVA, this was compared with pelvic tilt (PT), thoracic kyphosis (TK), lumbar lordosis (LL), and pelvic incidence-lumbar lordosis (PI-LL). Patients were divided into 3 groups by their (-)SVA for analysis: A=0 to >-35mm; B= -35 to >-65mm; C= ≤-65mm.

RESULTS

116 patients with AIS were reviewed. 85 had lateral radiographs and were included, 72 (84.7%) of these had a negative SVA. Mean negative SVA was -41.43mm; mean positive SVA was 22.99mm. New classifications for negative SVA were developed (Table 1): A=0 to >-35mm; B= -35 to >-65mm; C= ≤-65mm. Mean SVAs for group A, B, and C were -19.82mm, -46.59mm, and -75.40mm. Group A: mean LL=53.38°; mean PI-LL= -4.3°; mean PT=11.43°; mean TK=24.68°. Group B: mean LL=58.83°; mean PI-LL= -7.2°; mean PT=10.29°; mean TK=20.71°. Group C: mean LL=58.41°; mean PI-LL= -16.8°; mean PT=5.40°; mean TK=27.86°. Negative SVA correlations with PI-LL (R2=0.92), PT (R2=0.90), LL (R2=0.67), and TK (R2=0.21) were noted (Fig 1).

(-)SVA	0 >(-)35mm	(-)35 to (-)65mm	<(-)65mm
Value	A (normal)	B (negative)	C (very negative)
Frequency	31	26	14
Percent	43.66%	36.62%	19.72%
SVA mean	-19.82	-47.99	-77.09
LL mean	53.38	58.46	57.29
PI-LL mean	-4.3	-8.08	-15.64
PT mean	11.43	10.27	5.21
TK mean	24.68	21.08	26.17

Table 1. (-)SVA Classifications with their respective data from radiograph measurements.

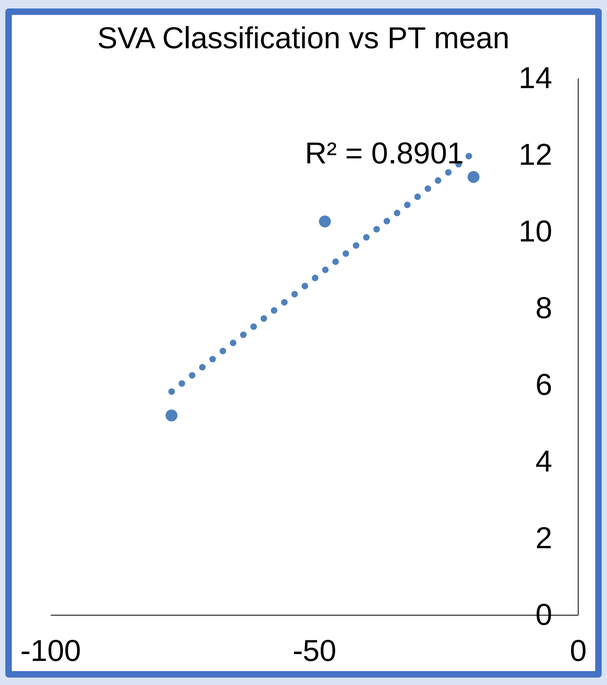

Fig 1. (-)SVA Classification means plotted against PT and PI-LL respectively

CONCLUSION

There is a high incidence of negative SVA in patients with AIS driving a negative plumb line because of thoracic hypokyphosis. Increasing negative SVA shows decreased PI-LL mismatch. Increased thoracic lordosis is associated with decreasing pelvic tilt to compensate and lower lumbar lordosis.

REFERENCES

1. Roussouly P, Nnadi C. Sagittal plane deformity: an overview of interpretation and management. Eur Spine J (2010) 19:1824–1836.

2. Glassman SD, Bridwell K, Dimar JR, Horton W, Berven S, Schwab F. The impact of positive sagittal balance in adult spinal deformity. Spine (Phila Pa 1976). 2005 Sep 15;30(18):2024-9.