



# “LESS IS MORE” SIGNIFICANT CORONAL CORRECTION OF AIS DEFORMITY PREDICTS THORACIC HYPOKYPHOSIS

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# Introduction

- Posterior approach with significant coronal plane correction of AIS deformity is associated with hypokyphosis and imbalance in the sagittal plane.
- Factors such as the pre-operative coronal curve magnitude, use of hooks, the number of levels fused, pre-operative kyphotic posture, screw density and rod type have all been implicated were also associated.
- Maintaining the normal thoracic kyphosis is important as hypokyphosis might be associated with proximal junctional failure and early onset of degenerative changes in the spine.

Our aim in this work was to study the association between the coronal correction successes with the sagittal balance outcome in AIS patients after posterior surgical correction.

# Methods

- Retrospective case series of patients with Lenke 1-2 surgically corrected via posterior approach using a standardized surgical technique with a minimum follow up of 2 years.
- Complete radiographical preoperative and postoperative were measured as well as the operative including:
  - UIV (divided into two Categories – T4 and above or below T5)
  - LIV (divided into two categories - L3 or below and above L3)
  - Metal density (% , number of instrumented pedicles vs total available)
  - Thoracic flexibility (% , MT correction  $\leq$  50% and  $>$ 50% in bending films).

# Results

- 95 cases included in our study (87% females, average age 14)
- 68 cases had thoracic correction of more than 60% (72%).
- Most cases had metal density of less than 80% (97.8%)
- Thoracic flexibility of more than 50% was found in 29 cases (31%).
- Preoperative hypo-kyphosis ( $<20^\circ$ ) was found in 24 cases (25.3%).

# Table 1

N=95			
Variables	Categories	Post op Thoracic Kyphosis	
		<20%	>20%
Thoracic correction, n(%)	<60%	6 (13.04)	21 (42.86)
	≥ 60%	40 (86.96)	28 (57.14)
*Sex, n(%)	Female	40 (86.96)	42 (87.75)
	Male	6 (13.04)	6 (12.50)
Mental Density, n(%)	< 80%	45 (97.83)	48 (97.96)
	≥ 80%	1 (2.17)	1 (2.04)
UIV , n(%)	T2-T4	44 (95.65)	44 (89.80)
	T5-T7	2 (4.35)	5 (10.20)
LIV, n(%)	T10-L2	31 (67.39)	37 (75.51)
	L3-L4	15 (32.61)	12 (24.49)
Thoracic flexibility, n(%)	<50%	33(71.74)	33(67.35)
	≥ 50%	13 (28.26)	16 (32.65)
Preop Thoracic Kyphosis, n(%)	<20%	15 (32.61)	9 (18.37)
	≥ 20%	31 (67.39)	40 (81.63)
Age, Median (IQR)	-	14 (11-16)	14 (12-17)
<b>TOTAL</b>		<b>46 (100%)</b>	<b>47(100%)</b>

- Post-operative thoracic hypokyphosis was **5 times more** likely in patients with thoracic correction  $\geq 60\%$  [OR 5.16 (95% CI, 1.79 - 14.91;  $p=0.002$ )], after adjusting for confounding variables.
- This association was not affected by metal density, thoracic flexibility, LIV, UIV, age or sex.

# Table 2

## Univariate Associations with post-operative thoracic

Univariate Associations with post-operative thoacic			
Variables	Categories	OR (95% CI)	P value
Thoracic correction	<60%	1	
	≥ 60%	5 (1.79 - 13.97)	0.002
*Sex	Female	1	
	Male	1.05 (0.31 - 3.53)	0.937
Metal Density	< 80%	1	
	≥ 80%	1.07 (0.06 - 17.57)	0.964
UIV	T2-T4	1	
	T5-T7	0.4 (0.07 - 2.17)	0.289
LIV	T10-L2	1	
	L3-L4	1.5 (0.61 - 3.66)	0.382
Thoracic flexibility	<50%	1	
	≥ 50%	0.81 (0.34 - 1.95 )	0.642
Preop Thoracic Kyphosis	≥ 20%	1	
	<20%	2.63 (0.95 - 7.24)	0.115
Age	-	0.93 (0.78 - 1.12)	0.456

Patients with thoracic correction of  $\geq 60\%$  are 5 times more likely to develop postoperative thoracic hypokyphosis when compared to patients with a thoracic correction of  $< 60\%$ .



# Table 3

## Multiivariate Associations with post-operative thoracic

Multivariate			
Variables	Categories	OR (95% CI)	P value
Thoracic correction	<60%	1	
	≥ 60%	5.16 (1.79 - 14.91)	0.002
*Sex	Female	1	
	Male	1.17 (0.31 - 4.41)	0.816
Age	-	0.99 (0.81 - 1.2)	0.94

Patients with a thoracic correction of  $\geq 60\%$  are 5 times more likely to have a post op thoracic kyphosis of less than  $20^\circ$  after adjusting for the effect of age and sex.

# Conclusion

**Our data correlates with the 'essential lordosis' hypothesis of Roaf (1966) and Dickson (1992) i.e.**

- With greater ability to translate the apical vertebra towards the midline there is a commensurate lengthening of the anterior column due to the vertebral wedging.**
- The lack of association with metal density or flexibility etc. suggests that this is an anatomical derivation rather than surgeon related.**
- We suggest that preservation of 'normal' thoracic kyphosis may require less coronal correction in preference for a balanced spine.**

**Thank  
you!**



# Disclosures

- none of the authors has any potential conflict of interest