

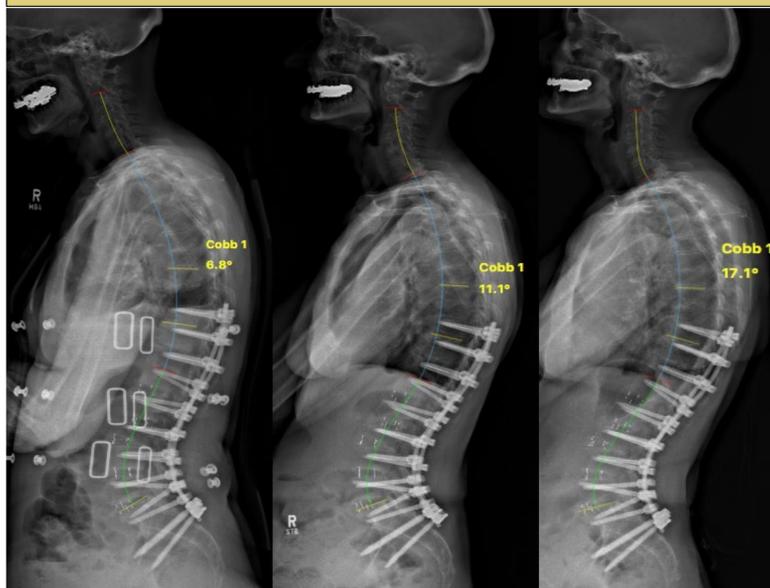
Background

- The insertion of pedicle screws via an open surgical exposure is a standard technique in sagittal plane deformity correction; however, this disrupts the posterior soft tissue envelope. The sacrifice of these structures may be an important factor in the development of proximal junctional kyphosis (PJK) and failure (PJF), and attempts are often made to preserve the midline tension band and the cranial segment facet capsule^{1,2}.
- The advent of minimally invasive spine surgery (MIS) techniques has allowed surgeons to insert pedicle screws with great accuracy whilst minimizing soft tissue disruption.³
- This preservation of the posterior soft tissue structures may contribute to the prevention of proximal junctional kyphosis (PJK) and failure (PJF).
- The impact of MIS techniques on the risk of developing PJK has not been well documented in long construct posterior spinal fusion (PSF) surgery.

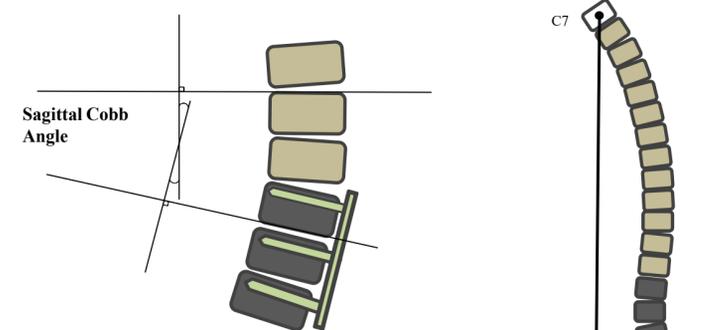
Objectives

- The purpose of this study was to evaluate the impact of preserving the cranial soft tissue envelope in long PSF constructs involving more than 5 spinal levels.

Methods

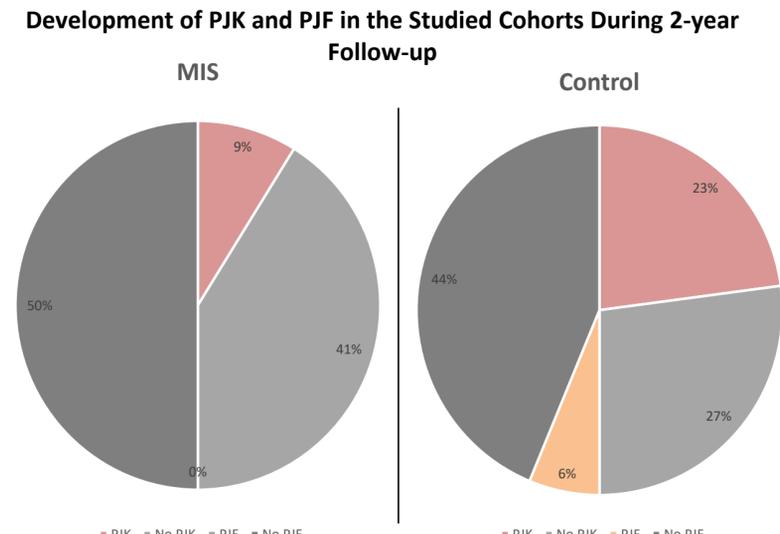


Radiographic Analysis of PJK, SVA, and SCA- (A) Images were measured using the Surgimap® imaging system.

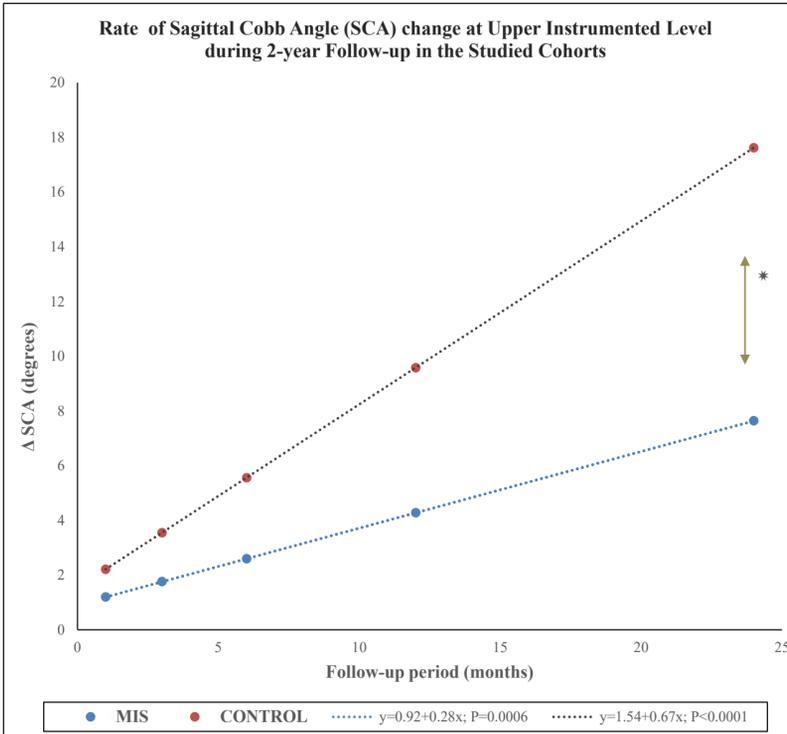


Radiographic Analysis of PJK, SVA, and SCA- (B) Sagittal vertical axis (SVA) was measured as the distance between the center of C7 and the posterior edge of the upper sacral endplate. Sagittal Cobb angle (SCA) was measured using the cranial border of the vertebrae 2 levels above and caudal border of the vertebrae 1 level below the most proximal instrumented vertebrae. Proximal Junctional Kyphosis (PJK) was defined as an increase in SCA ≥ 10 degrees over the study period.

Results



1. Development of PJK and PJF. The cumulative incidence of PJK was found to be higher in the control group as compared to the MIS group though these results did not reach statistical significance (82.3% vs. 17.7%, p-value = 0.1; OR = 0.25 [0.06, 1.12]). There was no difference in occurrence of PJF between the two groups at the end of 2 years (12.5% vs. 0%; p-value = 0.25).



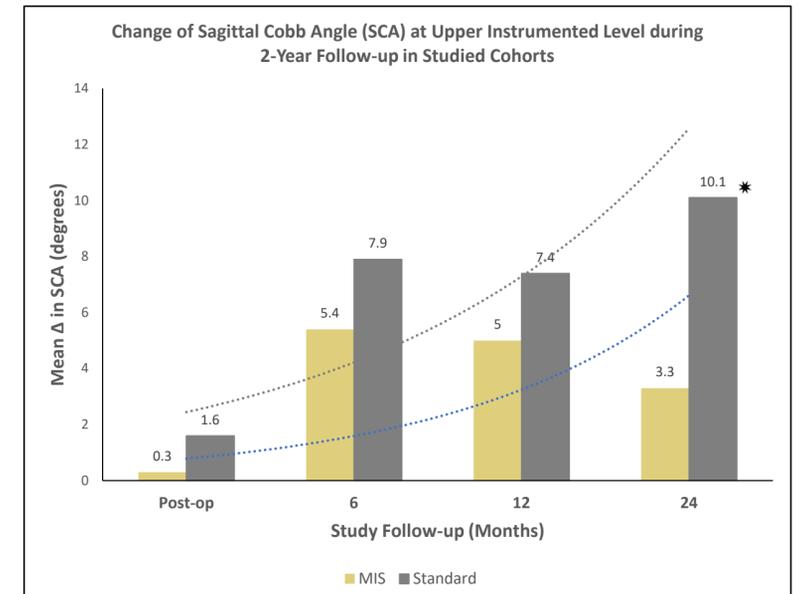
2. Rate of SCA change - Linear regression analysis showing SCA increases significantly in both groups during 2 years of postoperative observation. In the MIS group, this increase was on average 1.3 degrees per month (P=0.0006), while in the control group this increase was on average 2.2 degrees per month (P<0.0001). *The difference between these two regressions was statistically significant, P=0.003

References

- Shono, Y, et al. Stability of posterior spinal instrumentation and its effects on adjacent motion segments in the lumbosacral spine. *Spine (Phila Pa 1976)*. Journal Article. 1998. 23. 1550-8
- Yagi, M, et al. Incidence, risk factors, and natural course of proximal junctional kyphosis: surgical outcomes review of adult idiopathic scoliosis. Minimum 5 years of follow-up. *Spine (Phila Pa 1976)*. Journal Article. 2012. 37. 1479-89
- Anand, N, et al. Minimally invasive multilevel percutaneous correction and fusion for adult lumbar degenerative scoliosis: a technique and feasibility study. *J Spinal Disord Tech*. Journal Article. 2008. 21. 459-67

Characteristic (units)	Index	MIS (N= 17)	Control (N= 24)	Stat. test.	Coe f.	P-value
Number of levels fused	Mean (SD)	9.5(2.6)	8.6(2.7)	T, 2-tail	1.0	0.3
Anterior interbody fusion	Yes, N (%)	9(53)	10(42)	F(E), 2-tail	NA	0.54
	No, N (%)	8(47)	14(58)			
Osteotomy	Not used, N (%)	9(53)	10(42)	F(E), 2-tail	NA	0.8
	SPO, N (%)	5(29)	8(33)			
	PSO, N (%)	3(18)	6(25)			
Lower level of fusion	Lumbar N (%)	1(6)	6(25)	F(E), 2-tail	NA	0.048
	Lumbosacral N (%)	5(29)	12(50)			
	Sacroiliac N (%)	11(65)	6(25)			
Upper level of fusion	Upper thoracic (T4-T7)	2(11.8)	5(20.8)	F(E), 2-tail	NA	0.69
	Low thoracic(T8-T12)	14(82.4)	16(66.7)			
	Upper Lumbar (L1-L2)	1(5.8)	1(4.2)			
	Low Lumbar (L3-L4)	0(0)	2(8.3)			

MIS = minimally invasive surgical approach; Control = standard open access intervention; T = T-test; F(E) = Fisher's exact test ; SPO = Smith-Petersen osteotomy; PSO = pedicle subtraction osteotomy.



3. Change in SCA -The average SCA at the level adjacent to the most proximal instrumented vertebrae of the construct was compared to pre-operative levels in the MIS and control groups at the post-op (N=17, N=24), 6-month (N=17, N=24), 12-month (N=17, N=24), and 24-month (N=12, N=15) follow-up periods. There was a significant difference in the two groups at 24 months * post-op (3.3 vs. 10.1 degrees; p-value = 0.015) .

Conclusions

- Minimally invasive proximal screw stabilization showed a trend towards reduction in the risk of PJK and PJF after long posterior instrumented spinal fusion., though our results did not reach statistical significance
- The postoperative increase in sagittal Cobb angle at the upper instrumented vertebrae was less after the minimally invasive correction versus standard open technique. However, the obtained results should be regarded as preliminary which require further confirmation.