University of Colorado
Anschutz Medical Campus

Predictive modeling use in spine surgery

Evalina L. Burger, MD[1], Christopher J. Kleck, MD[1]

University of Colorado, Anschutz Medical Campus, School of Medicine, Aurora CO
[1]Department of Orthopedics

Disclosures:

- The authors have nothing to disclose.

Introduction

Adult spinal deformity surgery often has high complication rates that include malalignment, adjacent segment disease, and instrumentation failures[1-4]. Planning the desired correction to achieve sagittal alignment can reduce the complications[2]. However, it is unknown how the patient's spine will compensate above and below the construct, following the surgical correction. A predictive model is now utilized to simulate how the patient's thoracic kyphosis (TK) and pelvic tilt (PT) will compensate. Over 600 patients with 6-month follow-up were utilized in training and testing the predictive model (PM). The model uses projected lumbar lordosis and levels fused to provide the most likely postoperative TK and PT values.

Methods:

Two cohorts were analyzed for the mean error (ME) between the plan and postoperative results: (1) 38 patients without the PM and (2) 28 patients with the PM. The PM was also applied to cohort 1. All patients were fused from T10 through L1 to S1 or pelvis and had a minimum 6-month follow-up.

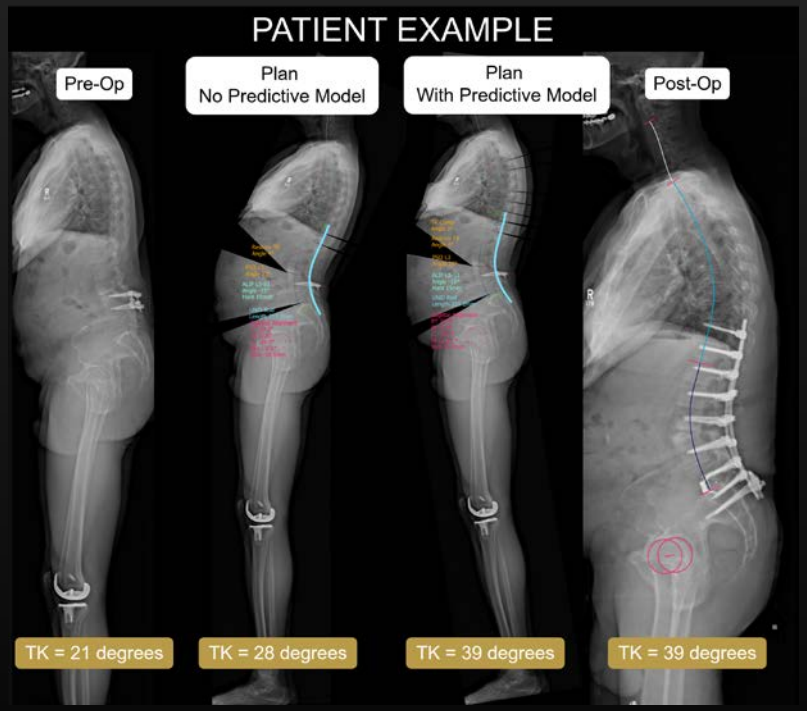
Results:

The mean error when comparing the plan and postoperative TK and PT was less when utilizing the predictive models. There was a significant difference in the mean error between cohort 1 and 2 for TK and PT and between cohort 1 and cohort 1 with the PM for TK. While there was not a significant difference between cohort 1 and cohort 1 with the PM for PT, the PM had less mean error.

	Mean Error of TK (deg)	Mean Error of PT (deg)
Cohort 1	13.2*†	6.5*
Cohort 2	6.6*	4.1*
Cohort 1 with PM	6†	5.4

*Statistical significant difference ($p < 0.05$) between cohort 1 and 2

†Statistical significant difference ($p<0.05$) between cohort 1 and cohort 1 with PM



Discussion:

The predictive model has the capacity to calculate the possible outcome of the surgery based on machine learning algorithms, in comparison to surgery planned without a predictive model. The accurate prediction of compensatory mechanisms after spinal realignment procedures, can play a significant role in the prevention of junctional failures. This methodology has the potential to reliably predict not only the correction, but also the unforeseen compensation of multiple parameters in the spine, allowing surgeons to adjust the planned corrections to be patient specific.

Conclusion:

The use of predictive models and machine learning can be utilized pre-operatively to help define the post-operative outcomes.

References:

1. Smith JS, Shaffrey CI, Ames CP, Demakakos J, Fu KMG, Keshavarzi S, et al. Assessment of symptomatic rod fracture after posterior instrumented fusion for adult spinal deformity. Neurosurgery. 2012;
2. Solla F, Barrey CY, Burger E, Kleck CJ, Fière V. Patient-specific Rods for Surgical Correction of Sagittal Imbalance in Adults. Clin Spine Surg. 2018;
3. Rothenfluh DA, Mueller DA, Rothenfluh E, Min K. Pelvic incidence-lumbar lordosis mismatch predisposes to adjacent segment disease after lumbar spinal fusion. Eur Spine J. 2015;
4. Passias PG, Soroceanu A, Yang S, Schwab F, Ames C, Boniello A, et al. Predictors of revision surgical procedure excluding wound complications in adult spinal deformity and impact on patient-reported outcomes and satisfaction. J Bone Jt Surg - Am Vol. 2016;

Thank You!