An Analysis of Clinical Deterioration Following Surgery for Adult Cervical Deformity

Bailey Thomas Imbo, Oscar Krol[1], Tyler Kade Williamson, Rachel Joujon-Roche, Peter Sergeyevich Tretiakov[1], Djani Robertson, Claudia Jane Bennett-Caso[2], Shaleen Vira[3], Peter Gust Passias[4]
[1]NYU Langone Orthopedic Hospital, [2]Orthopaedic and Neurological Surgery, [3]University of Texas Southwestern Medical Center, [4]NY Spine Institute / NYU Medical Center-Hjd

INTRODUCTION:
Cervical Deformity (CD)-correction has promising short-term clinical and radiographic outcomes for the majority of patients. A poor patient-reported outcome as described by the NDI, NRS Neck, and mJOA score can identify those patients who fared substantially worse following CD corrective surgery. This research proposes that patients who clinically deteriorate following CD surgery share common baseline characteristics.
METHODS:
Operative CD patients with pre (BL) and up to 2-year (2Y) postop radiographic/HRQL data were included. Clinical deterioration was defined as meeting two or more of the following criteria: 1) NDI$\geq$80 or $\geq$15 points from BL 2) NRS-Neck $\geq$ 8 or $\geq$2 points from BL 3) mJOA $\leq$12 or $\leq$2 points from BL. Factors predicting deterioration were identified using regressions and conditional inference tree (CIT) analysis determined threshold cutoffs. Several predictors were combined in a model to determine predictive value using receiver operating characteristic (ROC) curve methodology.
RESULTS:
221 CD patients were included, of which, 39 (17.6%) met criteria for clinical deterioration by 2Y. Age, gender and CCI were similar between groups, but patients who deteriorated had a higher BMI, $p<.05$. Patient groups also did not differ in EBL, operative time, and length of construct, all $p<.05$. Deteriorated patients presented with a larger sacral slope and C2-S1 SVA, both $p<.05$. Regression and CIT analysis identified the following predictors of clinical deterioration: BMI > 33 kg/m2 (OR 3.7 [CI 1.4–10.3] p=0.010), history of diabetes (OR 2.2 [CI 0.9–5.2] p=0.078), sacral slope > 41° (OR: 3.7 [1.4–9.8] p=0.010), C2-S1 SVA > 152mm (OR 7.8 [CI 2.0–30.7] p=0.004), C2 sagittal tilt > 9° (OR 9.6 [1.9–48.0] p=0.006), and C7 vertical tilt > 5° (OR 7.1 [CI 2.3–21.9] p=0.001). Multivariate analysis and ROC curve using these predictors adjusting for BL NDI, NRS Neck, mJOA, age, and CCI determined an AUC of 89.1%.
DISCUSSION AND CONCLUSION:
Clinical deterioration following CD-correction can be predicted both demographic and baseline radiographic factors. Constitution of the patient at risk for clinical deterioration can allow the surgeon to alter surgical planning and postoperative monitoring to maximize the opportunity for improvement following cervical deformity correction.