Spinal Pelvic Radiographic Thresholds for Regional Lumbar Disability are Age Dependent: Analysis of Multicenter database of 833 patients

Justin K Scheer BS; Justin S. Smith MD PhD; Virginie Lafage PhD; Christopher I. Shaffrey MD, FACS; Renaud Lafage; Eric Klineberg MD; Munish Gupta MD; Richard A. Hostin MD; Khaled Kebaish MD; Shay Bess MD; Frank Schwab MD, PhD; Christopher P. Ames MD

Introduction

The sagittal plane is the primary driver of disability in patients with ASD and spinopelvic radiographic thresholds have been established for pelvic tilt (PT), pelvic incidence (PI) and lumbar lordosis mismatch (PI-LL), and C7 sagittal vertical axis (SVA) in which disability occurs based on an ODI of =40. However, the patients' age was not accounted for in determining these thresholds and ODI has been shown to vary with age. The objective was to determine new thresholds based on age.

Methods

This is a multicenter, prospective study of consecutive ASD patients. Inclusion criteria included: age>18yr, ASD. Patients were stratified into the following age groups: =45yrs, 46-64, 65-74, =75. Multivariate linear regressions were conducted for baseline PT, PI-LL, and SVA with baseline ODI and age on all patients (Figure 1). Based on previous studies, an ODI of 40 was used as the threshold for disability. Individual patient thresholds were calculated based on their age. The thresholds were averaged across the age groups.

Figure 1

ALL (n=833)	Equation	r square	average thresholds	p value for regression
PT	LATpre_S1PT = 2.66248519773815 + 0.09114375508371*ODI + 0.28934039645963*AGE	0.266091	21.9 ± 4.7 deg	ODI: p=<0.0001, Age: p<0.0001
PI-LL	LATpre_PI_LL = -22.657663834125 + 0.27320287249929*ODI + 0.43206327290803*AGE	0.273322	11.6 ± 7 deg	ODI: p=<0.0001, Age: p<0.0001
SVA	LATpre_SVA_C7_S1 = -77.810101117329 + 1.5849805*ODI + 1.51796205255383*AGE	0.321771	6.7 ± 2.5 cm	ODI: p=<0.0001, Age: p<0.0001

Regression equations for calculation of thresholds

Table 1

Age group	Number	PT (deg)	PI-LL (deg)	SVA (cm)
≤45	218	15.3 ± 2.3	1.7 ± 3.5	3.3 ± 1.2
46-64	381	22.6 ± 1.5	12.5 ± 2.2	7.1 ± 0.8
65-74	172	26.2 ± 0.8	18 ± 1.2	9.0 ± 0.4
≥75	62	29.1 ± 0.8	22.4 ± 1.3	10.5 ± 0.4

Thresholds by age group.

Results

833 patients were included, (396 op, 437 nonop). Patients with only sagittal deformity for the age groups were the following: =45(18.8%), 46-64(19.4%), 65-74(40.1%), =75(50%). Age alone significantly predicted ODI (r2=0.17,p<0.0001). Regressions for PT(r2=0.27,p<0.0001), PI-LL(r2=0.27,p<0.0001, SVA(r2=0.32,p<0.0001) including age were all predictive of ODI. Thresholds for the entire cohort were the following: PT=21.9±4.7deg, PI-LL=11.6±7deg, SVA=6.7±2.5cm. Thresholds for the age groups are presented in Table 1.

Conclusions

Spinopelvic radiographic thresholds correlated to moderate to severe regional low back disability increase as patients age. These results suggest that pre-operative surgery planning and patient counseling should consider the patients age. Further study of Schwab SRS sagittal modifier correction goals for individual age groups is warranted.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) appreciate that the standard radiographic thresholds for disability vary based on the patients' age, 2) list the age adjusted radiographic thresholds, and 3) understand that preop surgical correction planning may need to include the patients age