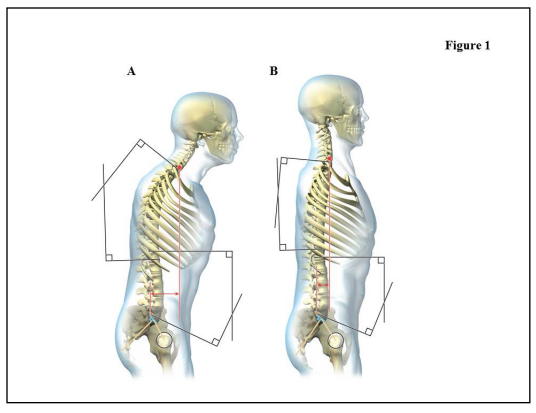
Surgical Treatment of Pathological Loss of Lumbar Lordosis (Flatback) in the Setting of Normal Sagittal Vertical Axis (SVA) Achieves Similar Clinical Improvement as Surgical Treatment for Elevated SVA

Manish Singh MD; Justin S. Smith MD PhD; Eric Klineberg MD; Christopher I. Shaffrey MD, FACS; Virginie Lafage PhD; Frank Schwab MD, PhD; Themistocles Protopsaltis MD; Gregory Mundis MD; Vedat Deviren MD; Robert Hart MD; Douglas C. Burton MD; Shay Bess MD; Christopher P. Ames MD; International Spine Study Group

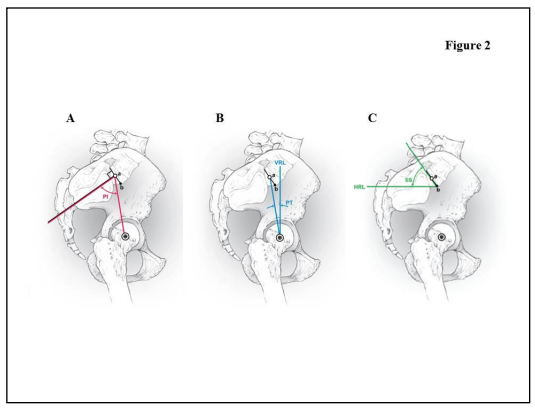
Introduction

Increased sagittal vertical axis (SVA) correlates strongly with pain and disability in adult spinal deformity (ASD). A subset of patients with sagittal spinopelvic malalignment (SSM) have flat back deformity (pelvic incidence-lumbar lordosis mismatch; PI-LL>10°) but remain sagittally compensated with normal SVA (illustrated in **Figure 1**). Few data exist for SSM patients with flat back deformity and normal SVA. Purpose: compare baseline disability and treatment outcomes for patients with compensated vs. decompensated SSM.



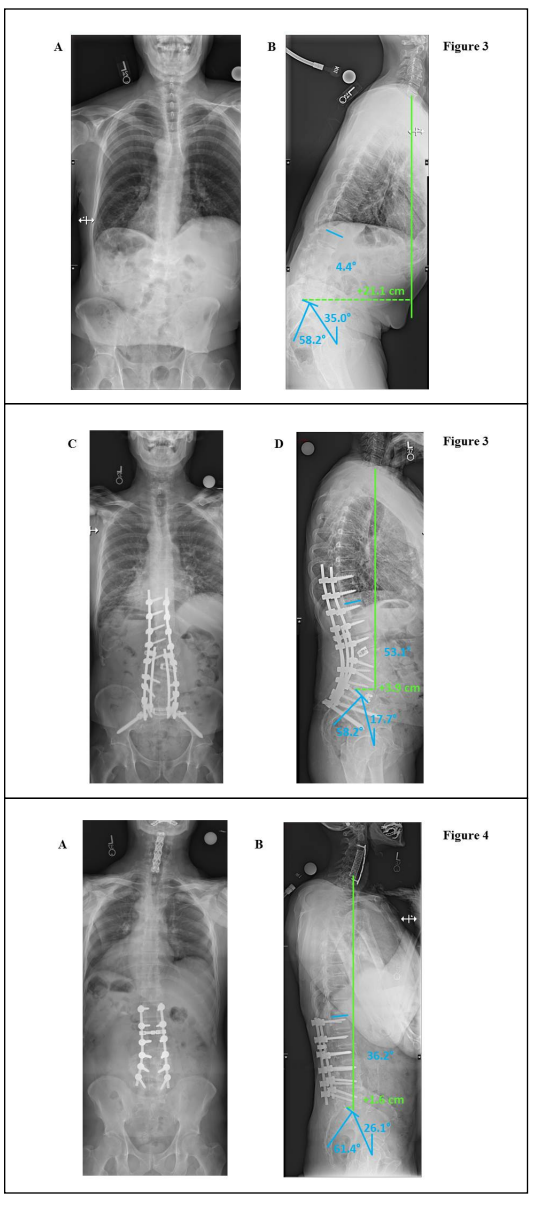
Methods

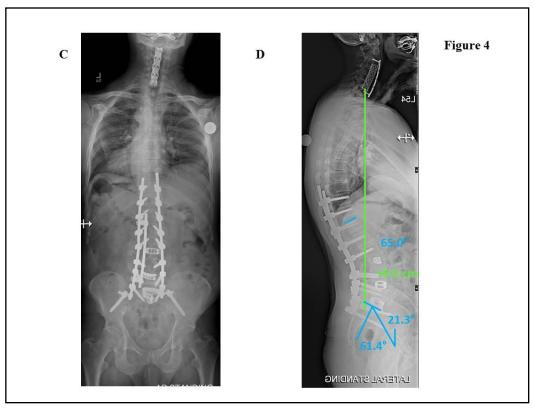
Multicenter, prospective, analysis of consecutive ASD patients surgically treated for SSM. Inclusion criteria: ASD, age>18, min 1-yr follow-up. SSM patients divided into two groups: 1) decompensated SSM (DECOMP) = SVA>5cm, 2) compensated SSM (COMP)= SVA <5cm and PI-LL >10°. Baseline and 1-yr follow-up radiographic and HRQL outcomes evaluated. Illustration of pelvic parameters is shown in **Figure 2**, including pelvic incidence (PI), pelvic tilt (PT), and sacral slope (SS).



Results

125 patients met inclusion criteria (DECOMP=98, COMP =27). A representative patient with decompensated sagittal spino-pelvic malalignment is shown in **Figures 3A -B** (SVA=21.1cm, LL=4.4°, PI=58.2°, PT=35.0°, PI-LL mismatch=53.8°); the same patient is shown following surgical correction in **Figures 3C-D** (SVA=3.9cm, LL=53.1°, PI=58.2°, PT=17.7°, PI-LL mismatch=5.1°). A representative patient with compensated sagittal spino-pelvic malalignment is shown in **Figures 4A -B** (SVA=1.6cm, LL=36.2°, PI=61.4°, PT=26.1°, PI-LL mismatch=25.2°); the same patient is shown following surgical correction in **Figures 4C-D** (SVA=0.5cm, LL=65.0°, PI=61.4°, PT=21.3°, PI-LL mismatch=-3.6°). DECOMP was older (63 vs 55 yrs, p=0.004), had less scoliosis (36° vs 51°, p=0.002), poorer HRQL (ODI, SF -36 PCS, SRS-22 total), greater SVA (12 vs 1.8cm), and greater PI-LL (27° vs 21°) than COMP, respectively (p<0.05). Both groups had improved postop SVA (DECOMP =4.8cm, COMP= -1.1cm; p=<.005) and improved postop PI-LL (DECOMP= 5°, COMP= 5°; p<0.001). Both groups improved in all HRQL measures (p<0.005). Magnitude of HRQL improvement and proportion achieving MCID was similar for both groups.





Conclusions

Significant disability occurs in decompensated SSM patients with elevated SVA, however, the amount of disability in compensated SSM patients with flat back deformity due to PI-LL mismatch but normal SVA is underappreciated. Surgical correction of SSM for both DECOMP and COMP demonstrated similar radiographic and HRQL improvements in both groups. Evaluation of SSM should extend beyond measuring SVA. PI-LL mismatch must be evaluated for SSM patients and can be considered a primary surgical indication.

Learning Objectives

By the conclusion, participants should be able to: (1) Understand the concept of mismatch between pelvic incidence (PI) and lumbar lordosis (LL); (2) Appreciate the importance of evaluating for PI-LL mismatch in adult spinal deformity patients; (3) Appreciate that a mismatch of PI and LL can be considered a primary surgical indication.