The Utility of Preoperative Magnetic Resonance Imaging in Predicting the Flexibility of Sagittal Imbalance

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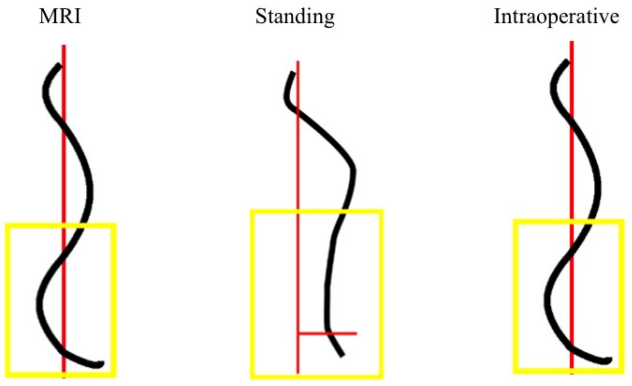
Introduction

Flatback deformity refers to the loss of normal lumbar lordosis and can result in sagittal imbalance. Surgical treatment of sagittal imbalance has been noted to improve quality of life. Scoliosis x-rays are the gold standard for assessing preoperative lumbar lordosis; however, particularly for flexible deformities, a standing radiograph cannot predict the thoracolumbar alignment after intraoperative positioning.



Preoperative MRI predicts intraoperative lumbar lordosis better than standing x-rays

Methods

The authors retrospectively identified 138 patients with sagittal imbalance, undergoing a total of 148 fusions of the lumbar spine. The patient sample included 42 men and 96 women with a mean age of 61 years. Demographic clinical, and radiographic parameters, including the pelvic incidence and lumbar lordosis were obtained from images preoperatively and at 6 months and 2 years follow-up. Health and quality of life outcomes were evaluated using the patient-reported EQ-5D, PDQ, and PHQ-9, preoperatively and at 12 months follow-up.

Results

The mean difference was only 2.9 degrees between the lumbar lordosis measured on supine MRI as compared to the intraoperative x-rays. However, the difference in lumbar lordosis between standing x-rays and intraoperative x-ray was 5.53 degrees. In patients with a flexible deformity (n=24), the lumbar lordosis measured on MRI more accurately predicted the intraoperative lumbar

At 12 months, the flexible cohort exhibited pre- to postoperative improvement that was significant for the EQ-5D ($p = 0.0026$), PDQ ($p = 0.0048$), and PHQ-9 ($p= 0.018$). However, a matched cohort of non-flexible deformities showed no statistically significant change in pre- to postoperative patient reported outcomes at 12 months.

Patient Demographics and Clinical Parameters*

Variable	Value
Number of Patients	138
Number of Procedures	148
Age at Surgery (yrs)	61.1 ± 13.1
Male sex	42 (30)
Posterior Approach	52 (35)
Number of Levels Fused	7.4 ± 2.9
Locations of Levels Fused	
T10 - Pelvis	81 (55)
Proximal Thoracic (T1 - T6) - Pelvis	28 (19)
L2,L3 - Pelvis	39 (26)
Number of PSO	22 (14)
Length of Surgery (Min)	397.6 ± 103.2
Blood Loss (L)	1.8 ± 1.6
Length of Stay (Days)	7.2 ± 3.6
Revisions	13
Instrumentation Failure	10
Pseudoarthrosis	3

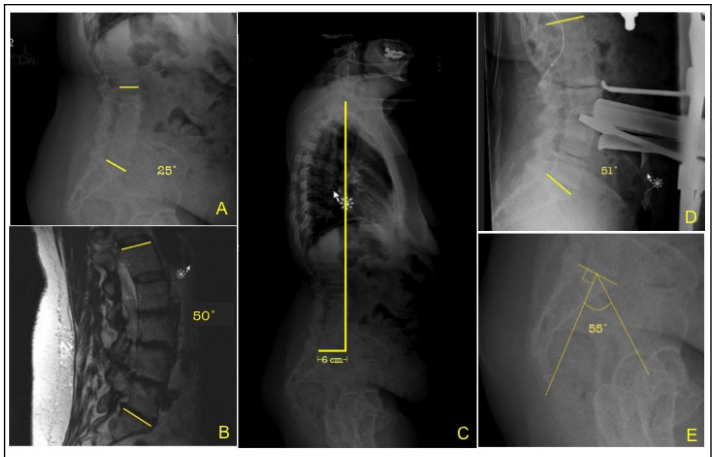
* Values are expressed as mean ± SD for continuous variables and number (%) for categorical variables.

Conclusions

The discrepancy between MRI and the standing X-rays determined which sagittal deformities were flexible. Within the flexible cohort, lumbar lordosis measured on MRI accurately predicted the intraoperative lumbar lordosis. Flexible sagittal deformities had better clinical outcomes with surgery than the non-flexible, matched cohort.

Learning Objectives

By the conclusion of the session, participants should be able to 1) recognize the discrepancy between standing and intraoperative x-rays, and 2) understand the evolving of supine MRI for surgical planning in the treatment of flexible sagittal imbalance.



6 cm C7 SVA and 30 PI-LL mismatch on standing x-rays, however 5 PI-LL mismatch on MRI. Pelvic incidence (e) and C7 SVA (c) were measured from standing x-rays. Non-weight bearing MRI (b) is shown to be more predictive of intraoperative lordosis (d), when compared to lordosis measured on standing lateral x-ray (a).

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