

# The Impact of Positive Sagittal Balance in Adult Spinal Deformity

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### FROM ABSTRACT:

#### Study Design.

This study is a retrospective review of 752 patients with adult spinal deformity enrolled in a multicenter prospective database in 2002 and 2003.

Patients with positive sagittal balance (N = 352) were further evaluated regarding radiographic parameters and health status measures, including the Scoliosis Research Society patient questionnaire, MOS short form-12, and Oswestry Disability Index.

#### Objectives.

To examine patients with adult deformity with positive sagittal balance to define parameters within that group that might differentially predict clinical impact.

#### Summary of Background Data.

In a multicenter study of 298 adults with spinal deformity, positive sagittal balance [**forward head / body**] was identified as the radiographic parameter most highly correlated with adverse health status outcomes.

#### Methods.

Radiographic evaluation was performed according to a standardized protocol for 36-inch standing radiographs. [**IMPORTANT: the analysis in this study was a measurement for forward head / body done on an upright full-spine lateral x-ray**]. Magnitude of positive sagittal balance [**forward head / body**] and regional sagittal Cobb angle measures were recorded.

Statistical correlation between radiographic parameters and health status measures were performed.

Potentially confounding variables were assessed.

#### Results.

The C7 plumb line deviation ranged from 1 to 271 mm. [**about 11 inches**]

All measures of health status showed significantly poorer scores as C7 plumb line deviation increased. [**WOW!**]

Patients with relative kyphosis in the lumbar region had significantly more disability than patients with normal or lordotic lumbar sagittal Cobb measures.

## Conclusions.

This study shows that although even mildly positive sagittal balance is somewhat detrimental, severity of symptoms increases in a linear fashion with progressive sagittal imbalance.

The results also show that kyphosis is very poorly tolerated in the lumbar spine.

## THESE AUTHORS ALSO NOTE:

With respects to spinal deformities, "investigators have begun to apply reproducible evaluation techniques, including standardized radiographs, gait analysis, and validated health status measures."

"In a recent multicenter study of 298 adults with spinal deformity, positive sagittal balance was identified as the radiographic parameter most highly correlated with adverse health status outcomes."

[Glassman SD, Berven S, Bridwell K, et al. Correlation of radiographic parameters and clinical symptoms in adult scoliosis. Spine 2005;30:682-8.]

"Positive sagittal balance was defined as an anterior deviation of the C7 plumb line measurement." **[Like a forward head or forward body syndrome]**

"Positive sagittal balance was more significantly associated with pain and disability than curve magnitude, curve location, or coronal imbalance."

The purpose of this study was to examine patients with adult deformity with positive sagittal balance **[a forward head or forward body syndrome]** to define parameters within that group that might differentially predict clinical symptoms.

Patient self-assessment measures of health status collected were the Scoliosis Research Society patient questionnaire (SRS-29), MOS short form-12 (SF-12), and Oswestry Disability Index (ODI).

In this study, "radiographic measures of deformity were recorded based on a standardized manual of measurement techniques." Anteroposterior and lateral 36-inch standing radiographs were exposed. **[IMPORTANT: standing AP and lateral full-spine 36-inch radiographs were used].**

"Coronal plane parameters included major and minor curve location, curve magnitude by Cobb angle, and coronal imbalance by C7 plumb line deviation."

"The sagittal balance [anterior-posterior] was determined based on the deviation of the C7 plumb line, originating at the middle of the C7 vertebral body, from the posterior superior endplate of S1."

"Positive sagittal balance was defined as an anterior deviation of the C7 plumb line." **[Like a forward head or forward body syndrome]**

"Patient reported health status measures, including the SF-12, SRS-29, and ODI, were analyzed to determine a relationship between type, location, or magnitude of deformity, and overall health status, pain, and function."

## RESULTS

"Positive sagittal balance [forward head or forward body syndrome] based on C7 plumb line deviation ranged from 1 to 271 mm (mean  $57.7 \pm 51.2$ )."

There was a high degree of correlation between positive sagittal balance and adverse health status scores, for physical health composite score and pain domain. **[Important]**

"There was clear evidence of increased pain and decreased function as the magnitude of positive sagittal balance increased." **[Important]**

"All measures of health status (SF-12, SRS-29, and ODI) showed significantly poorer scores as C7 plumb line deviation increased."

"There was no significant correlation between thoracic or thoracolumbar sagittal Cobb deformity and any of the health status measures."

## DISCUSSION

An increasing number of patients with adult deformity are seeking medical care.

"Several [surgical] studies have shown that adequate restoration of sagittal plane alignment is necessary to improve significantly clinical outcome and avoid subsequent pseudoarthrosis."

"Positive sagittal balance [**forward head / body**] has also been identified as the radiographic parameter most highly correlated with adverse outcome measures in unoperated adult spinal deformity."

"This study shows that although even mildly positive sagittal balance is somewhat detrimental, severity of symptoms increases in a linear fashion with progressive sagittal imbalance."

Kyphosis is "very poorly tolerated in the lumbar spine."

"These findings emphasize the importance of thoroughly accessing sagittal plane alignment in the treatment of spinal deformity."

"With surgical treatment, maintenance or restoration of lumbar lordosis appears to be critical."

**KEY POINTS FROM AUTHORS:**

- 1) Severity of symptoms increases in a linear fashion with progressive positive sagittal balance.
- 2) Relative kyphosis is very poorly tolerated in the lumbar spine.
- 3) The use of reproducible radiographic and clinical outcome measures facilitates the development of more effective treatment paradigms for patients with adult deformity.

**KEY POINTS FROM DAN MURPHY:**

- 1) The analysis in this study was a measurement for forward head / body done on an upright full-spine lateral x-ray.
- 2) These authors measured the sagittal plumb line distance between the center of C7 vertebral body with respects to the superior posterior surface of the sacrum.
- 3) This study showed a deterioration of health status with progressive forward head / body sagittal balance.
- 4) All measures of health status showed significantly poorer scores as C7 plumb line deviation increased forward of the sacrum.
- 5) Even minor forward head / body sagittal balance is detrimental.
- 6) The severity of symptoms increases in a linear fashion with progressive increase of forward head / body sagittal imbalance.
- 7) Kyphosis is very poorly tolerated in the lumbar spine.
- 8) There was clear evidence of increased pain and decreased function as the magnitude of forward head / body sagittal balance increased.
- 9) "These findings emphasize the importance of thoroughly accessing sagittal plane alignment in the treatment of spinal deformity."
- 10) Relative kyphosis is very poorly tolerated in the lumbar spine.