

# COMMENTARY

## Cobb's Angle in Scoliosis – Gold Standard or Golden Calf? A Commentary on Scoliosis Outcome Assessments

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### Abstract

The purpose of this paper is to discuss why Cobb's angle should not be the Gold Standard for radiographic evaluation of scoliosis. While Cobb's angle has been the subject of numerous reliability studies, there are several disadvantages to be noted. These disadvantages range from high inter-examiner variability to lack of validity. Cobb's angle is oftentimes only as good as the film it is drawn upon. There are various alternative methods that involve measuring the Cobb angle as well as its rotational component. Since chiropractors are particularly focused on obtaining radiographic evidence of treatment success, the profession at large should use radiographic analytical methods that provide more information on the presenting three-dimensional spine and spinal disorder.

**Key Words:** *Chiropractic, scoliosis, Cobb angle, radiograph, x-ray, mensuration*

### Introduction

Scoliosis is classically described in the literature as a curvature of the spine greater than 10 degrees on radiographic study. This measurement is taken using a Cobb angle, a measurement first illustrated decades ago in an effort to quantify scoliotic curvatures and the progression or correction thereof.<sup>1</sup> Classically, the Cobb angle has been the gold standard for assessing spine curvatures both in the sagittal and coronal planes. While this measurement has remained through the decades as the chief outcome assessment in scoliosis, this measurement has both a high degree of variability and virtually no validity. It provides no information on segmental

or global spinal function, it gives little insight as to the risk of curve progression, it does not correlate to any subjective outcome, and it provides only two-dimensional information about a three-dimensional spine, hence failing to account for vertebral rotation. Since there are other newer methods to evaluate spine structure, which have a higher degree of reliability, we will discuss our opinion in this article that the Cobb angle should be abandoned for scoliosis radiographic evaluation.

### Measurement Issues

Cobb's angle has been the subject of numerous reliability studies. From an intra-examiner standpoint, a single

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practitioner's Cobb angle will vary anywhere from 2-5 degrees, depending upon whether the image is a plain-film radiograph, CT, or MRI study.<sup>2-6</sup> The inter-examiner variability is unfortunately much higher, approximating 20 degrees or higher in some studies.<sup>7,8</sup>

Aside from the high degree of measurement variability, even the best Cobb angle measurement is only as good as the film it is drawn upon. Weinert<sup>9</sup> demonstrated changes in anatomical measurements with only small incremental changes in patient positioning in radiographic practice models used in chiropractic colleges. In this study, ten degrees of rotation, for example, caused a six millimeter change in the width of the sacrum, as well as a six millimeter difference between the heights of the femur heads. One can predict the difficulty in repeating an x-ray of a scoliosis patient with a marked degree of pelvic rotation, which creates a significant amount of projectional distortion. Moreover, scoliosis radiographs are best taken with the central ray located at the level of scoliotic apical vertebra. This helps create a single point of origin from which to measure future comparative studies on full-spine 14"x36" radiographs. Since this method fails to account for issues such as pelvic positional changes on subsequent studies, a full-spine film lends to high variability, even when Cobb's angle is drawn with 100% reliability.<sup>10</sup>

Another disadvantage of using the Cobb angle to evaluate scoliosis is its lack of validity. Many signs and symptoms of scoliosis, such as reduced pulmonary function, may be related more to the rotational displacement caused by scoliosis compared to any lateral bending component. Cobb's angle, however, does not account for spine rotation, since it is purely a two-dimensional measurement. To accommodate for these pitfalls, additional forms of measurement have been created, such as the scoliometer, and Nash-Moe and Perdriolle measures of vertebral rotation. By contrast, surgeons report significant reductions in Cobb's angle measurements following spinal arthrodesis. Despite these reported corrections, as many as 40% of these patients will be classified as permanently disabled as a result of the surgery, yet the Cobb angle is reduced.<sup>11</sup>

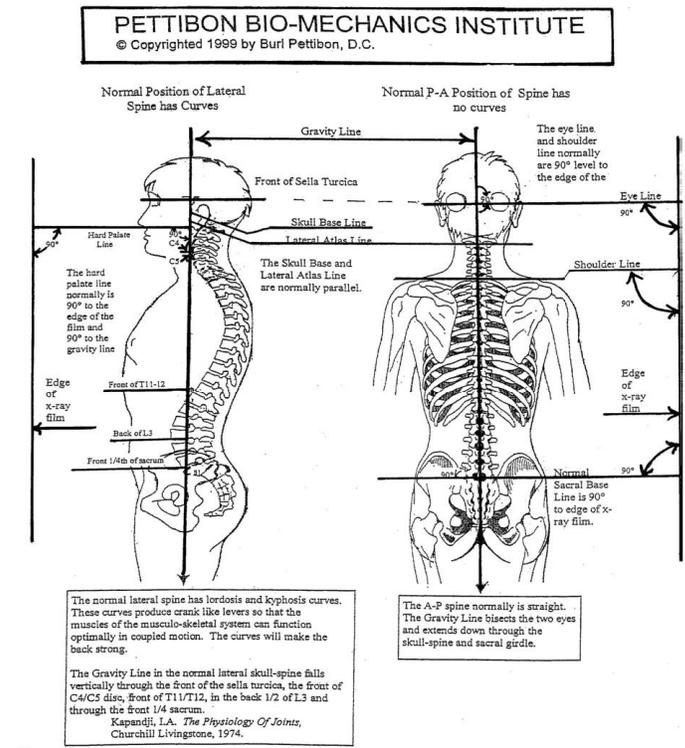
### Alternatives

There are other methods out there that may provide more insight into the pathomechanics of the spine in conditions such as scoliosis. For example, methods that take into account the rotational component of the spine have demonstrated a high level of reliability.<sup>14-19</sup> Some of these methods locate the position of the spinal cord itself relative to the spine, suggesting that it's position is more important than the osseous components, with which we agree. Tension on the spinal cord from structural deviations may cause systemic CNS symptoms, as demonstrated in animal models.<sup>20,21</sup> A measurement system for anteroposterior radiographs illustrated by Pettibon takes into account both the lateral bending component of spinal displacement (Cobb angle) as well as the rotational aspect (Perdriolle, Nash-Moe). This measurement system focuses on locating the center of the spinal canal, giving an approximation of the spinal cord's location in a given patient's radiographs.<sup>17</sup>

Figures 1a and 1b show an illustration of how this

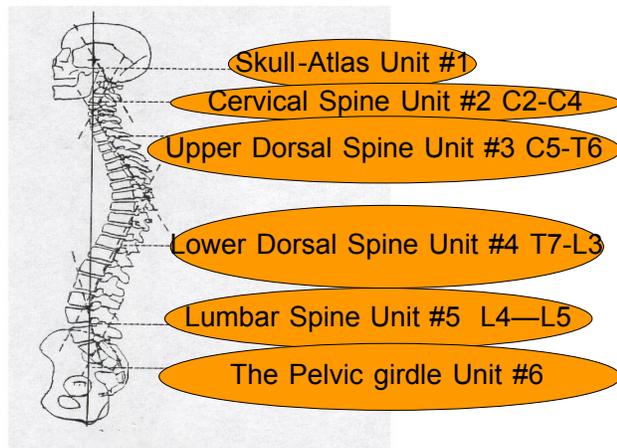
measurement system identifies the center of the spinal canal. In this analysis, the spine is broken down into distinct functional units, based upon their respective muscular attachments. When viewing the spine as functional units, we find that it can be broken down into six individual lever arms that transmit forces along the spine as well as to dissipate the force of gravity throughout the spine.<sup>22</sup> This minimizes the deleterious effects of chronic gravitational loading at any one spinal joint. This is illustrated in Figure 2. In this model, spinal canal measurements are identified at the following vertebral levels: C2,C5,T2,T7,T8,T12,L3,L5. These levels correspond to those segments functioning as transition segments between units (C2,C5,T7,T8,L3,L5) or those segments located in the middle of the two longest spinal lever arms (T2,T12) where functional breakdown is thought to initially occur by some authors.<sup>22</sup> Perhaps not coincidentally, some of these segments are very frequently considered the apex of thoracic and thoracolumbar scoliosis patterns (T7, T12, L3).

Figure 1a. Pettibon Spinal Model



Other chiropractic methods of analysis have demonstrated good reliability as well; as they take three-dimensional spinal structure into account. Harrison et al, for example, calculated the amount of artificial measurement change based upon the difference in patient placement from pre- to post-treatment studies.<sup>23</sup> Another advantage of these systems is their use of sectional radiography for biomechanical analysis instead of full-spine imaging.<sup>24,25</sup> Since full-spine imaging inherently contains multiple origins from which to measure (the skull and

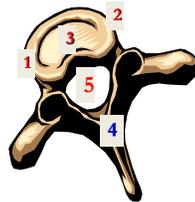
**Figure 1b. Functional Units**



**Figure 2. Center of Neural Canal**

### To Find the Center of the Neural Canal on A-P X-rays

- Place dots on the inner most lateral vertebral body (#1 & #2).
- Half way between is the center of the vertebral body (#3).
- Dot the spino-laminar junction (#4)
- Half way between #3 & #4 is the spinal cord!



pelvic), projectional distortion may result in radiographic images that look dramatically different.<sup>10</sup> Sectional radiography allows the clinician to aim the central ray of the x-ray tube at the level of the biomechanical origin present on a given film (skull for nasium or cervicothoracic views; sacrum/pelvis for lumbopelvic views), thus minimizing projectional distortion on the resultant radiograph.

Aside from skeletal radiography altogether, other methods of spinal imaging are emerging. For example, the use of surface topography<sup>26</sup> can reduce the amount of necessary radiographic studies to properly manage scoliosis cases with a high risk of progression. Surface topography can detect significant changes in Cobb angles, but each method focuses on different aspects of the scoliotic deformity. However, surface topography can be effectively used to monitor changes in scoliosis in place of radiographic Cobb angles, without sacrificing the standard of care.<sup>27</sup> Another radiation-free method for evaluating spinal curvature using the Ortelius 800 has been shown to provide a near-identical quantification to

that of radiographic Cobb angles.<sup>28</sup> This device provides a computer-based graphical image of the spine, providing both sagittal and coronal measurements. As this technology becomes more refined and developed, it may offer private practitioners a completely non-invasive means of imaging the spine in three dimensions.

### Outcomes

At a 2005 consensus meeting of the Society on Scoliosis Orthopedic and Rehabilitation treatment, the society as a whole created a list of outcomes related to scoliosis treatment with various outcomes listed by importance. This society is comprised of the world's foremost authorities on the non-operative treatment of scoliosis. The importance of Cobb's angle ranked 12<sup>th</sup> after the consensus meeting, with outcomes such as disability, psychological well-being, and balance ranking higher.<sup>29</sup> Aesthetics and quality of life ranked number one and two respectively. This outcome list has very important ramifications for chiropractic clinicians and researchers who focus on scoliosis and its treatment. Because of the intimate relationship between chiropractic care and spinal radiography, using the Cobb angle as a primary, if not sole, outcome assessment has been the traditional barometer for both chiropractic and traditional medical interventions here in the United States. However, chiropractors can take a large step forward by acknowledging and using the prioritized outcome list as a benchmark for future scoliosis research designs and interventions.

Aside from radiographic outcomes, which rank lower in importance than cosmetic or physiological outcomes, chiropractors and other manual medicine practitioners may well serve their scoliosis patients by providing these other outcomes measures in place of or in conjunction with radiographic parameters, depending upon each case as it presents. For instance, surface topography can be used to monitor scoliosis patients. Using surface topography satisfies the most highly ranked outcome, aesthetics. As mentioned, quality of life is the next most important outcome. Feise et al<sup>30</sup> created and validated a patient index called the scoliosis quality of life index. An index such as this should be used by all manual medicine practitioners when treating patients with scoliosis. Other physiological outcome assessments are currently being explored, such as peak expiratory flow, rib cage expansion, and spirometry.<sup>31,32</sup>

### Conclusion

Scoliosis is a multi-dimensional disorder. Biomechanically, scoliosis is a three-dimensional deformity of the spine. However, the radiographic Cobb angle measurement only provides two-dimensional information. This in and of itself should make the measurement obsolete, given the availability of other published radiographic methods such as those outlined here. Use of a Cobb angle, especially on full-spine radiographs, assumes that the patient placement on a full-spine film is consistent from pre- to post-treatment studies.

Since chiropractors are particularly focused on obtaining radiographic evidence of treatment success, the profession at large should use radiographic analytical methods that provide more information on the presenting three-dimensional spine

and spinal disorder. We as a profession should also consider using a wide array of radiographic, functional, and index-based outcomes to get a complete picture of patient progress. When we as clinicians begin to only treat radiographs, we tend to lose sight of the fact that there is a patient attached to that spine.

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