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The Transformation of Spinal Curvature into Spinal Deformity

A recent review[1] aims to summarize what is known about the structural and functional changes, by which spinal curvatures develop and evolve into spinal deformities.

The authors begin their paper by stating,

"The defining property of humans and other vertebrates is the vertebral column, housing as it does a multifaceted sensory-response system integrating every aspect of movement, form, and function. Therefore it is not surprising that a deformity of the spine can be associated with a diverse array of pathological consequences."

The authors report that they undertook a comprehensive review of articles published on 'scoliosis,' whose content yielded data on the pathological changes associated with spinal curvatures. Medline, Science Citation Index and other searches yielded > 10,000 titles each of which was surveyed for content related to 'pathology' and related terms such as 'etiology,' 'inheritance,' 'pathomechanism,' 'signs and symptoms.' Additional resources included all books published on 'scoliosis' and available through the Arizona Health Sciences Library, Interlibrary Loan, or through direct contact with the authors or publishers.

The authors, in outlining the results of their review, suggest that a lateral curvature of the spine-'scoliosis'-can develop in association with postural imbalance due to genetic defects and injury as well as pain and scarring from trauma or surgery. Irrespective of the factor that triggers its appearance, a sustained postural imbalance can result, over time, in establishment of a state of continuous asymmetric loading relative to the spinal axis.

The authors believe that recent studies support the longstanding hypothesis that spinal deformity results directly from such postural imbalance, irrespective of the primary trigger, because the dynamics of growth within vertebrae are altered by continuous asymmetric mechanical loading. Furthermore, the data suggests that, **as long as growth potential remains, evolution of a spinal curvature into a spinal deformity can be prevented by reversing the state of continuous asymmetric loading.**

In concluding the authors state,

"A significant body of research now has demonstrated that, whatever the initial trigger that induces a spinal curvature, asymmetric loading of the spinal axis produces biomechanical forces that can account for most if not all progression of the spinal deformity. The data, taken together, suggest that there is a threshold for continuous asymmetric loading that must be reached before vertebral changes occur, and that transient loading will not foster asymmetric growth leading to deformity. Structural damage to bone and disc can occur very early in the development of even minor curves. **Yet the damage can be reversed entirely if steps are taken to reverse the loading imbalance while significant growth potential remains.** These data suggest that preventing a state of continuous asymmetric loading in children in early stages of scoliosis will prevent the development of spinal deformities. Continued research to develop methods to quantify the status of spinal loading in individual patients, and thereby define its potential for causing curvature progression, is of paramount importance. In the meantime, sufficient data in support of the 'vicious cycle' model are available to justify empirical studies to explore the use of simple daily exercises or other interventions. Such exercises, designed to interrupt steady state spinal loading at the apex of the curvature, can be predicted to forestall the cascade of molecular events that transform benign spinal curvatures into progressive spinal deformities."

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Reference:

1) Hawes MC, O'brien JP. The transformation of spinal curvature into spinal deformity: pathological processes and implications for treatment. Scoliosis 2006;1:3. http://www.scoliosisjournal.com/content/1/1/3