The Scoliosis Traction Chair

Applying Research & Science to Clinical Rehabilitation Technology

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DISCLAIMER: *This article is not intended to promote or sell a product in any way, but rather to explain how research can be applied practically towards the development of clinical rehabilitation technologies. The Scoliosis Traction Chair is not available for sale to the general public, or even to licensed Doctors of Chiropractic. It is only sold to doctors who are certified in the system of chiropractic scoliosis correction developed by the CLEAR Scoliosis Institute, and their patients.*

In 2001, a scientist at the State University of New York in Stony Brook received a grant from NASA to study how whole-body vibration (WBV) could be used to achieve therapeutic benefits to the musculoskeletal system.[1] The outcome of his work soon led to a general craze about WBV therapy, with additional researchers at other universities branching off to study other aspects of WBV, and marketers developing numerous platforms designed to capitalize on the research suggesting WBV therapy as a potential intervention for osteoporosis and other common ailments.

When the initial studies on WBV began to be published - as is the case with most initial research forays into new technologies - at first the findings were only suggestive of the opportunities for further research. Many times important parameters of WBV therapy - such as the frequency, amplitude, and direction of the vibratory waveform – were not reported, or were described only vaguely. As the importance of these factors in achieving specific outcomes began to be realized, additional studies were performed to determine how changing one factor might influence the results.

WBV therapy was first studied for its effects on bone formation, joint flexibility, and muscle tone. As an inductive science, research cannot be counted upon to provide all of the answers. If something has not been researched yet, after all, there can be no relying upon research to prove or disprove its efficacy. Rather, common-sense and deductive reasoning (commonly known as logic) are required.

Doctors of chiropractic understand how stimulation of muscle spindles increases stimulation of the cerebellum and other areas in the brain responsible for postural control through the process of afferentation. Researchers trying to understand how WBV therapy increased bone density postulated that it could be because of increased stimulation of postural muscles; as these long, strong muscles contracted, they stimulated bone growth through adaptive responses.[2,3] Using deductive reasoning, it was hypothesized that if WBV increased the activity of the muscles, it could also increase the rate of afferentation occurring between the brain and the postural muscles, and thus promote better balance, proprioception, and posture by increasing the rate at which the body and the brain communicate with each other. If this rate of communication is increased, postural rehabilitation exercises performed with the aid of WBV therapy should be more effective than exercises performed alone.

Problems with vestibular function, proprioceptive deficits, and issues with postural control have all been observed in patients with idiopathic scoliosis.[4,5] These balance-related disorders are also common to another segment of the population; namely, people living with Parkinson's disease. In a recent study investigating the effect of WBV therapy on improving balance & postural stability in patients with this condition, a significant benefit was found.[6] Although the effect of WBV therapy on improving vestibular deficits in scoliosis patients has not been specifically investigated, it is logical to assume that it may be similarly effective.

The most common management strategy for idiopathic scoliosis is orthopedic bracing; one of the most common braces used in North America is the Boston brace, developed in the early 1970's by Dr. John Hall and Mr. William Miller of the Boston's Children's Hospital. Unfortunately, the rate of scoliosis surgeries has been steadily increasing since the 1980's, when this brace achieved common usage.[7]

The action of a rigid brace such as the Boston brace, or any inflexible orthosis, is quite simple: it restricts motion. Immobilization results in muscle atrophy and degeneration of synovial joints, including the intervertebral discs of the spine. At the University of Vermont, the biomechanicist Dr. Ian Stokes performed a series of animal experiments that clearly demonstrated when motion was inhibited at the level of the IVD, the structural rigidity of the spine increased.[8] This has dramatic implications for scoliosis bracing; if bracing is applied in a case of early-onset scoliosis, and bracing inhibits spinal mobility, could the resultant disc degeneration actually contribute to the development of a permanent spinal deformity? This is a question worth raising, in line with *primum non nocere*.

A study conducted by the Department of Mechanical Engineering at L'Ecole Polytechnique in Montreal, Canada, suggests that the fundamental philosophy behind the application of bracing may be flawed. Examining the problem from a purely biomechanical point of view, the researchers at L'Ecole Polytechnique suggested that, in fact, the Boston brace might be more beneficial if the current design were reversed - to paraphrase, the results could be improved if the brace were worn backwards:

> *"Boston brace treatment produces complex trunk motions that tend to shift the spine and rib cage anteriorly, with little de-rotation and lateral displacement to the left, whereas ideal expected correction would be the opposite."*
>
> *"A more optimal way to achieve trunk corrections could be made by applying loads laterally on the convex side and on the anterior thoracic opposite the rib hump, with a system that constrains mechanically the posterior rib hump from moving backward."* [9]

When compressive forces are applied to the body, the instinctive reaction is for the body to resist against it. By wearing a brace for several hours out of each day, the body develops a neuromuscular pattern of continually resisting against the applied force. When the brace is removed, the rebound effect, combined with muscles weakened by atrophy, could actually lead to increased progression of the scoliotic curvature.

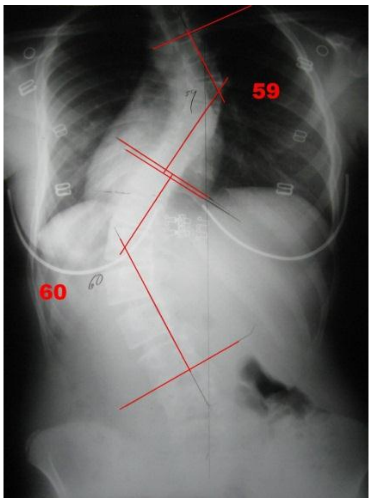
Considering how the body responds to compressive forces, perhaps a different mechanism could be applied to achieve better results; namely, tractive or pulling-type forces. Pulling, as opposed to pushing, is less readily resisted by the body, and thus works with the body rather than against it. Greater reduction of spinal deformity could potentially be achieved when the muscles are engaged to facilitate the improvement rather than fight against it or be immobilized by the external forces applied.

Another important aspect to consider regarding the scoliotic deformity is its three-dimensional nature. The very term “scoliosis” is misleading, as it implies a lateral curvature of the spine. While scoliosis may be commonly measured and diagnosed in this fashion (namely Cobb angle), the sagittal and axial planes are also involved and contribute to the etiopathogenesis and progression of this spinal disorder.[10] For this reason, it is more appropriate to refer to the scoliotic spine as a ‘helix,’ rather than a curve.[11] Bracing is fundamentally flawed, due to its inherent inability to address the spine in all three dimensions. CT and three-dimensional x-ray systems consistently show that, even in cases of bracing where the lateral deviation of the spine as measured by Cobb angle is reduced, there is a worsening of the sagittal balance and no effect on the axial vertebral rotation[12] (which, through the attachment of the ribs, is primarily responsible for the cosmetic deformity that is considered to be pathognomonic for the disorder of scoliosis). A more effective system of spinal correction should be measured not only by its ability to reduce the deformity in the coronal plane, but also in the other two dimensions (high school experiences aside, most of the people we encounter in life are not one-dimensional).

The earliest systems of spinal instrumentation did not address the axial or sagittal planes; in fact, Harrington rods caused a worsening of sagittal balance.[13] New methods do not focus purely on the correction of the spine in the coronal plane, and one of the reasons used to justify the higher cost of newer systems of spinal instrumentation is the improved three-dimensional correction they can achieve.[14]

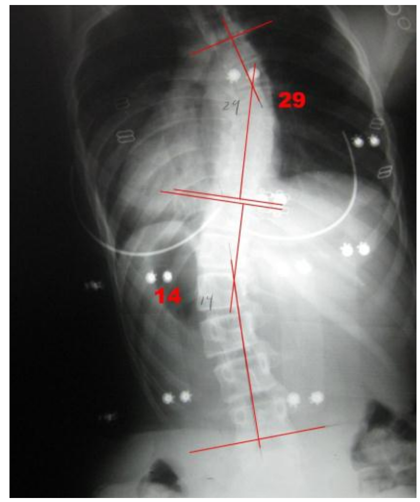
It is interesting to note that axial spinal traction is the earliest described form of treatment for scoliosis, and its role in the management of scoliosis has been well-documented over the centuries,[15] yet today spinal traction is seldom used in the management of scoliosis. At one point the Milwaukee brace (the precursor to the Boston brace) incorporated a cervical halter which aimed at providing axial traction to the spine, but it was discontinued due to its social unacceptability as well as its unfortunate side effect of inducing TMJ problems in brace wearers. Currently, traction is used in the orthopedic management of scoliosis only in a hospital setting; under general anesthesia to evaluate the flexibility of the spine prior to surgery, and hence predict the post-surgical prognosis; and, halo traction (pins drilled into the skull and attached to a pulley unit), used pre-operatively to increase the flexibility of the curve and thus the improvement achievable through surgery. The historical foundations & reported benefits of axial traction should not be ignored; the one universal constant acting on all of our spines is gravity. It is common knowledge that the height of an individual is decreased throughout the day, sometimes by as much as a half-inch, due to the effect of constant gravitational loadbearing upon the intervertebral discs. A three-dimensional system of scoliosis management must by its very nature involve axial traction; the only alternative, axial compression, is intrinsically opposed to good spinal health. If traction can be used to increase flexibility of the spine and enhance long-term outcomes, it deserves to reclaim its place in the conservative management of spinal deformity.

Combining these observations and building upon published research, a chair was created that incorporates whole-body vibration (to stimulate motor-sensory communication between the brain & body along the spinocerebellar tracts) along with lateral traction (to pull, rather than push, the spine towards the ideal), axial traction (to decrease spinal rigidity and facilitate reduction of the deformity in the other two planes), and de-rotation (focusing on unwinding a helix rather than straightening a curve) to treat scoliosis more comprehensively, in all three dimensions. In preliminary clinical trials, this new device appears to have greater result in reducing not only the lateral deviation as measured by Cobb angle, but also the de-rotation as measured by Nash and Moe.[16]



Pre-Treatment

In-brace

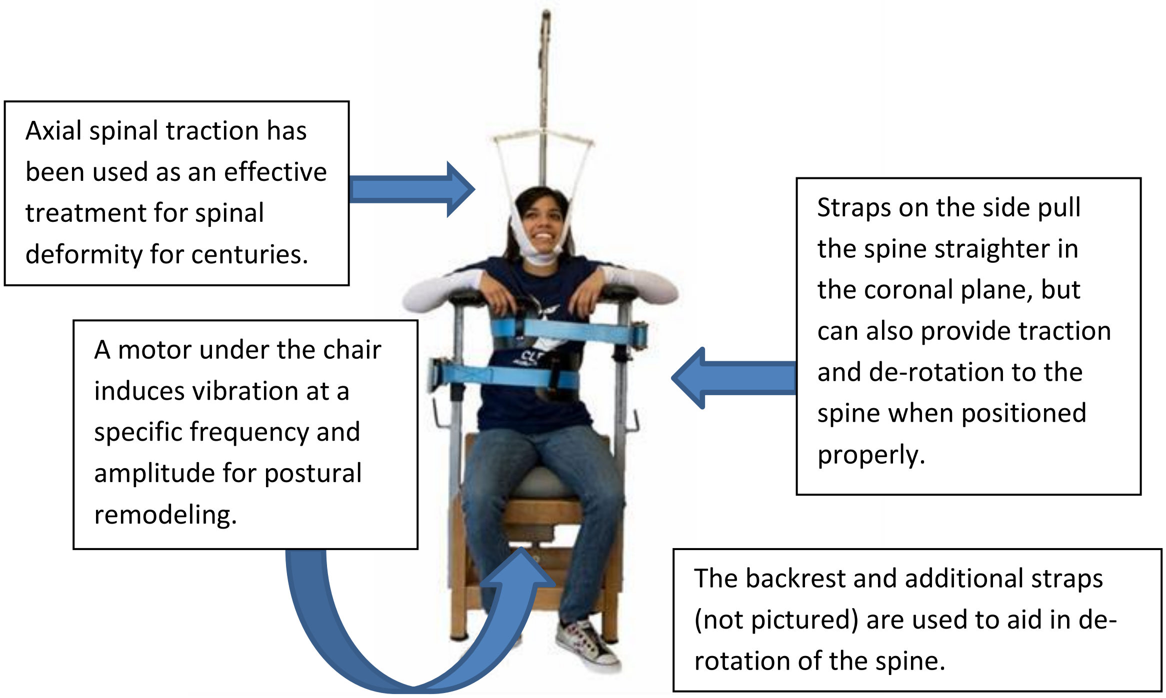


In the Scoliosis Traction Chair

In the initial radiograph, the patient demonstrates a 59 degree thoracic Cobb angle and 22.5% rotation of the thoracic apical vertebra (T6), and a 60 degree Cobb angle with 24.5% rotation of the apical vertebra (L1).

In brace, the patient's Cobb angles measure 55 and 49 (a 4 and 11 degree improvement respectively), and the rotation measures 35.1% and 29.5% (a 12.6% and 5.0% worsening respectively).

In the Scoliosis Traction Chair, the patient's Cobb angles measure 29 and 14 degrees (a 30 and 46 degree improvement respectively), and the rotation measures 19% and 17.9% (a 3.5% and 6.6% improvement respectively).



A thorough understanding of current research & research methods is of invaluable benefit to the treating clinician. In addition to providing solid evidence about current treatment methods, it suggests opportunities for future innovations in spinal rehabilitation and wellness promotion strategies.

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