

The Pettibon System: A Neurophysiologic Approach to Spine and Posture Correction

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The structure of the spine, and ultimately posture, are considered by some to be a requisite to maintaining health and normal function.³ Abnormal posture can cause alterations in some of our basic physiological processes, such as headaches, blood pressure, emotions, lung capacity, and hormonal production.⁴ Yet maintaining an erect sitting position is difficult because postural control is mainly reflexive and involuntary. Therefore, although we can temporarily change our posture through voluntary muscular action, inevitably our conscious control bows to our reflexive, neurological control of posture. From this, we can logically presume that the best way to make a lasting change to spinal structure, or posture, is to correct posture from a reflexive, involuntary standpoint. This logic forms the foundation for a treatment protocol referred to as The Pettibon System developed by Pettibon^{37,38} to correct the spine and posture through gradual adaptation of the spinal and postural reflexes.

A fundamental difference in the overall medical education of a chiropractor is the amount of importance placed upon restoring and maintaining the integrity of the nervous system. Given that the nervous system controls and regulates all other body functions,¹² it is logical that it also controls spinal and postural position and movement. However, chiropractic treatment has typically shown little success in making gross structural and postural changes.^{16,29} The procedures used in The Pettibon System, in contrast to conventional chiropractic treatment, heavily emphasize the importance of postural and paravertebral soft tissues in making structural changes. Although most chiropractors also incorporate physical exercises into their treatment regimens,^{22,23} these exercises usually attempt to change postural through voluntary neuromotor pathways. They include mirror-image type exercises, where postural isotonic exercises are performed in mirror-image fashion to the patient's presenting posture. However, since we know that posture is under reflexive control, it is much more difficult to change posture through voluntary means.

From a biomechanical perspective, chiropractors typically view the spine as a series of 24 movable segments. As a result, chiropractic manipulation is typically delivered on a segmental basis, using a variety of exams performed to locate a singular misaligned vertebra. In contrast, The Pettibon System treats the skull as a vertebra. Further, it is regarded as the single most important vertebra, given that most of the reflexes that govern postural control are housed within the skull, such as the visual system and vestibular apparatus. With these neurophysiologic capabilities, the skull is the only vertebra that can orient itself to time and space. Many of our postural reflexes, such as the vestibulocollic reflex,⁴⁷ cervicocollic reflex,³⁵ pelvo-ocular reflex,³¹ vestibulo-ocular reflex,³⁹ cervico-ocular reflex, and cervical somatosensory input,^{41,30,49} all serve to maintain a level head position in relation to the visual field or to the neck and trunk. Therefore, correcting the static structure of the cervical spine becomes a primary goal in correcting overall spinal and postural position and movement, as the rest of the spine orients itself in a top-down fashion.³⁴ Once this is achieved, the rest of the spine is corrected according to the normalized reference point.

Normal vs. Abnormal

Like any physiologic process, the spine and posture must also possess a normal measurement. Just as blood pressure, serum cholesterol, body temperature, and blood pH have normal values, so too must static spinal structure. The spine serves two distinct functions: 1) provide protection for the spinal cord, and 2) provide structural support for the bony frame. In providing this structural support, one common denominator exists for all upright bipedal mammals: gravity. Given that gravity is a constant on Earth, a corollary to the second spine function is that it also serves to adapt to gravity, while allowing for a balance between support and flexibility. Various authors have attempted to identify a normal spinal model.^{5,9,10,11} Most recently, Harrison et al.^{5,17,20,26} and Troyanovich et al.⁴⁴ outlined their definition of a normal sagittal spine by using elliptical shell modeling. They conclude that the normal cervical curve should be a 42.5° arc of a circle from C2-C7, the thoracic kyphosis should be a 44.2° ellipse when measured from T1-T12, and the lumbar spine should be a 39.7° ellipse from L1-L5. According to Kapandji²⁷, each of these three areas should measure 45° arcs of a circle. The inherent problem with an ellipse is the fact that an ellipse contains a stress point. The arc of a circle, on the other hand, is radially loaded, meaning that an arc does not contain stress points. When modeling the lumbar spine as an arc instead, as Kapandji²⁷ does, each of the lumbar segments bears the weight of the trunk uniformly. Therefore, it seems logical to use the Kapandji spinal model as a clinical goal compared to sagittal ellipses. The spinal model proposed by Pettibon,³⁸ adapted from the parameters identified by Kapandji,²⁷ is pictured in Figure 1.

In discussing the concept of a normal spine, it is also important to address the idea of clinical symptoms in spine correction. Although clinical trials have not been conducted, theoretical models have attempted to demonstrate the inevitable result of chronic abnormal spinal loading. For example, a forward head posture can reverse the stresses placed upon the cervical spine. This causes degenerative changes at the anterior portion of the mid and lower cervical spine due to increased compressive force at these areas.^{19,21} It also creates traction stress along the posterior longitudinal ligament, thereby promoting traction spur development. This concept is supported in a recent study by Wiegand et al.,⁴⁵ where abnormal changes in cervical spine configuration correctly predicted cervical pathology 79% of the time. A significant relationship has also been shown between cervical spine pathology and symptoms. Ironically, although cervical pathology may be present with abnormal cervical spine structure, the relationship between an altered cervical spinal structure and clinical symptoms is tenuous at best.³⁶ However, it could be postulated, as in the case of scoliosis progression,⁴⁸ that because the cervical spine pathology may develop slowly over time, the body continuously adapts to the abnormal position and advancing pathology. Therefore, symptoms do not develop until a critical point has been reached, such as neuroforaminal stenosis or spinal canal stenosis, eg. cauda equina syndrome.

The ultimate purpose of identifying a normal spine and posture is simply to provide a reference point from which a clinical goal can be developed. Spinal correction as a clinical goal and outcome is becoming more important and necessary in a society where musculoskeletal complaints total nearly \$50 billion in health care spending annually.⁶ With the growing interest occurring in spinal correction, consensus on a

normal sagittal spine is desirable so that randomized trials and outcome assessments in the clinical setting can be designed and tested.

Pettibon Manipulative Procedures

The Pettibon System uses a collection of manipulative techniques, performed both by hand or adjustive mechanical instruments, and rehabilitative exercises not known to the typical physiotherapeutic arsenal.³⁹ The manipulative and rehabilitative procedures are applied on an individual basis, so that every treatment plan can be designed according to each patient's needs. A brief look into the biomedical literature reveals that using a combination of manipulation and rehabilitative exercises seems to outperform either modality alone in achieving various clinical outcomes.^{2,13,24} Classically, the goal of chiropractic manipulation is to correct misalignments within the spinal column. However, the literature available to support this idea is limited at best. In The Pettibon System, by contrast, spinal manipulation is performed in order to provide a temporary increase in joint mobility so that the rehabilitative exercises can take advantage of this increased range of motion. Central to this system is the idea that the manipulation is not the corrective procedure; rather, the rehabilitative exercise becomes the corrective procedure. The limited corrective ability of spinal manipulation stems from the neurophysiologic adaptations to sudden applied mechanical forces. According to Guyton,¹⁴ when the spine is subjected to sudden mechanical forces, the paravertebral soft tissue is stretched, eliciting intrinsic dynamic and static stretch reflexes in the paraspinal muscles. These reflexes cause a reflex contraction of the stretched muscle until the muscle has restored its initial resting length. Therefore, spinal manipulation performed alone does not address or counteract these reflex properties of the spine that are designed to protect it from potentially injurious external mechanical forces.

Rather than addressing the spine as a series of individual segments, Pettibon^{37,38} addresses the spine according to the muscular attachments of the postural muscles. Through this the spine is conceptualized as a functional entity made of six specific units, divided by these muscular attachments. Although the individual vertebrae have independent motion, they do not move independently within a functional confine. Therefore, the specific goal of manipulative treatment in The Pettibon System is to mobilize a region of vertebral segments described by its common muscle attachments. How muscle attachments relate to Pettibon's model of six functional units can be found in Tables 1, 2 and 3.

The manipulations performed by hand also differ from conventional chiropractic methods. Typically, compressive-type manipulative forces are administered in conventional chiropractic. These forces are vectored perpendicular to the predominantly vertical orientation of the paravertebral soft tissue, especially in the cervical spine. Therefore, these soft tissues cannot adapt to this direction of force efficiently, and may sustain injury from this type of manipulation. In contrast, The Pettibon System uses distraction and accumulative type manipulative procedures. The forces applied in the distraction procedures are vectored more cranially, thereby allowing the vertically oriented soft tissue to better adapt to the forces with less chance of injury. The accumulative force procedures represent the positional traction procedures.

Pettibon Rehabilitative Procedures

The heart and soul of Pettibon rehabilitative procedures is the patented (US Patent #740087.403C1) Pettibon Weighting System™ (Fig.2). Its goal is to realign the centers of mass of the head, trunk, and pelvis. It incorporates the use of head, shoulder, and hip weights placed at specific areas with varying amounts of weight, depending upon the patient's needs. Since we know that the spine attempts to distribute body weight evenly around the vertical axis of gravity, placing asymmetrical weights on the external body surface causes the postural reflexes and spine to adapt to the change in weight distribution, re-orienting this added weight around the vertical axis. In a study by Saunders et al.,⁴⁰ with 131 patients, initial neutral lateral cervical radiographs were compared to lateral cervical radiographs with patients wearing 3 lb or 5 lb. frontal headweights. On average, the cervical lordosis improved 34%, while the amount of forward head posture was reduced by 14 mm in patients wearing 5 lbs. Those wearing 3 lbs. experienced a 31% improvement in cervical lordosis and 18mm reduction in forward head posture. In a smaller study by Morningstar et al.,³² 15 patients underwent a series of three manipulative procedures, and were then fitted for a 4-lb frontal headweight. Radiographic measures of cervical lordosis improved 9.9° and forward head posture reduced 1.25 inches. While these studies have shown that external body weighting does make spinal changes, their position is key to successful treatment.

Cailliet³ described adding weight to the top of the head to treat cervical hyperlordosis. However, a previous study¹⁷ has shown that in a non-patient population, the average cervical lordosis is 34°, less than the normal value of 42.5° identified by Harrison et al.¹⁵ and 45° outlined by Kapandji²⁷ and Pettibon³⁸. Therefore, adding weight to the top of the head to reduce cervical lordosis seems contraindicated for a majority of the population. However, the Pettibon headweight is positioned on the patient's forehead just above the eyes, causing a posterior skull translation versus a superior translation. The postural reflexes attempting to rebalance the skull's new center of mass mediate this posterior translation. This results in a reduction of the forward head posture and increase in the cervical lordosis.

The Pettibon Weighting System is also considered a type of "isometric demand exercise" where the weighting system retrains and strengthens weaknesses in the postural muscles. Because patients vary in height, weight, shape, muscular strength, and medical history, the practitioner cannot assume that the same abnormal posture in two different patients will associate with the exact same muscle weaknesses. The Pettibon Weighting System can only be accurately utilized in conjunction with radiographic measurements because the reliability of visualizing cervical and lumbar sagittal alignment is extremely low⁸. Therefore, all patients must undergo radiographic analysis while wearing the weighting system designed specifically for them. While concerns tend to arise regarding radiation exposure to the patient, the dosage used is always minimal. In fact, Toppenberg et al.⁴³ concluded that it would take 2500 cervical spine x-rays or 1250 lumbar spine x-rays to approach the radiation safety limit of 5 Rad for a fetus.

Another important aspect of the rehabilitative procedures used in The Pettibon System is that they are intended to address the biomechanical properties of soft tissue. Hysteresis, for example, is the stored energy in viscoelastic tissues, like muscles,

ligaments, and discs, that is decreased when these tissues are subjected to progressive loading and unloading cycles over time.⁴⁷ Since muscles, ligaments, and discs are the structural “glue” of the spinal column, it is logical then to address these tissues when attempting to make changes in the static structure of the spine. In The Pettibon System, exercises are performed to decrease hysteresis in these tissues using the Wobble Chair™ (Fig.3) and the Pettibon Repetitive Cervical Traction™ (Fig.4). From a clinical standpoint, the exercises are performed at the beginning of a patient visit prior to manipulative intervention. This reduces the overall resistance of the soft tissues to the manipulative force, thus allowing that force to assume a more corrective role. Once the manipulative techniques are administered, the patient then wears the Pettibon Weighting System while the soft tissue is less resistant. Therefore, in The Pettibon System, all of the components of the spine are corrected and rehabilitated as a unit, using rehabilitative procedures designed to target each type of tissue specifically.

Finally, another type of isometric exercise is used to rehabilitate normal spine alignment. Kendall et al.²⁸ demonstrated this exercise for the treatment of scoliosis, and Pettibon has slightly modified the performance of these exercises by creating the Linked Exercise Trainer™ (Fig.5) on which they are performed. The ways in which these exercises are performed change the functional origin and insertion of the muscle. For example, the action of a rhomboid muscle is to retract the scapula, when the spinous processes of the mid thoracic vertebrae serve as the origin. However, when the scapula is alternatively stabilized as the origin, the rhomboid now pulls on the thoracic spinous processes, thus acting as a vertebral rotator muscle. Hence, this muscle can be used to correct evidence of coronal curvatures in that region. Areas of muscle imbalance can therefore be isolated and strengthened using the Linked Exercise Trainer, thus reinforcing corrective spinal changes.

Pettibon Radiographic Analysis

For radiographic analysis to be reliable, the quantification of patient progress on pre- and post-treatment x-rays must not be nullified by inconsistent patient placement. Harrison et al.¹⁸ showed that small deviations in patient placement can alter the amount of cervical lordosis by 6.9°. A pilot study by Stitzel et al.⁴² found that inconsistent bite line positioning on lateral cervical radiographs can result in up to a 20% measurement error. Therefore, The Pettibon System uses the bite line as a reference point for lateral cervical radiographs.

The Pettibon System also uses seated x-ray analysis rather than the standard standing or recumbent positions. From a theoretical standpoint, seated x-rays may reduce the amount of potential variability in patient positioning because the lower extremity cannot effect the overall positioning. Furthermore, a seated position increases the stress on the lumbar spine by 25%. Studies assessing the clinical validity for seated lumbar films in detecting and grading spondylolistheses are currently being conducted. This method of patient positioning produces a radiographic measurement error of only one-half to two-thirds of a degree in the cervical spine.²⁵

Dynamic radiographic study is also performed in The Pettibon System. Cervical and lumbar flexion and extension studies help the practitioner locate areas of spinal

instability due to ligamentous disruption. This analysis is performed according to the American Medical Association's Guide to the Evaluation of Permanent Impairment¹ enabling the practitioner to document soft tissue injuries commonly overlooked in recumbent and static x-rays.

Testing Prospective Patients for Treatment

Patients presenting to a conventional chiropractic facility will typically provide a full case history, be subjected to some type of examination including palpatory, neurological, and orthopedic testing, and undergo special studies such as plain film radiography, magnetic resonance imaging (MRI), ultrasound, or computerized tomography (CT). As long as there are no contraindications to manipulative treatment, such as fracture, malignancy, marked instability, dislocation, or prior surgical intervention, all patients are accepted for treatment, regardless of prognosis. The Pettibon System, in contrast, allows for individualized patient testing to help determine, *before treatment begins*, whether or not benefits are likely.

This patient testing is performed by weighting the patient's head and shoulders according to his/her preliminary x-ray findings. While wearing weights, the patient performs a series of exercises on the Wobble Chair, followed by specific stretching exercises. Afterwards, the initial x-rays are retaken, but this time while wearing the head and shoulderweights. For example, if the patient's cervical curve improves measurably, and the forward head posture is reduced, then the patient can be expected to achieve a significant outcome. However, if the cervical spine measurements worsen, then the patient does not possess adequate muscle strength and/or endurance. At this time, if the patient "fails" this test, he/she is not accepted as a candidate for treatment. However, the patient may elect to participate in a strengthening program for a specified time period. Once this program is completed, the patient is re-subjected to the testing protocol, and if improvement is obtained, the patient is then accepted for treatment.

Phase of Care

The Pettibon System is divided up into three distinct phases: acute care, rehabilitation and correction, and maintenance and supportive care. The goals of the acute phase, which lasts from 14 to 21 days, include reducing or eliminating the patient's symptoms as quickly as possible, improving joint range of motion, and beginning the restoration of normal sagittal spine alignment. Patients receive training on home care equipment and procedures that they must do twice daily for strengthening postural muscles and building endurance. At the end of acute care, patients are re-x-rayed to assess their progress and qualification for rehabilitation and correction. This phase of care requires three treatments per week, based upon the common knowledge that muscle strength gains are achieved when a muscle is fully exercised three times per week. Rehabilitation and correction continues until normal sagittal and coronal spine alignments are achieved. This typically takes from 90 days to 24 months, depending upon the extent of injuries, age of the patient, chronicity of the presenting complaint, and patient

compliance. Finally, maintenance and supportive care focuses upon making the structural changes long lasting, through weekly workouts using the Linked Exercise Trainer and training in lifestyle habits to support the patient's health goals.

Preliminary Data

Although many of the individual parts of The Pettibon System have been peer-reviewed, any treatment method should also seek to provide outcome data on the overall method to determine effectiveness, risks, side effects, and target populations. To date, two studies outlining two specific subsets of patient populations have been conducted. In a progressive study by West et al.⁴⁶, 200 of a possible 1936 patients met the inclusion criteria for this study. Of these, 177 participated in the trial intervention. Each patient was evaluated using a visual analog scale (VAS), range of motion quantification, plain-film radiography, and CT or MRI to rule out treatment contraindications. These patients were treated by manipulation under anesthesia (MUA) using The Pettibon System manipulative methods. Following the full MUA protocol, patients with cervical complaints reported an average 62.2% improvement in VAS scores, while patients with lumbar complaints reported a similar 60.1% improvement. A 68.6% decrease in patients out of work and 64.1% return to unrestricted activity 6 months post-MUA was achieved. Finally, there was a 58.4% reduction in prescription pain medication usage, and 24% required no medication six months after the MUA.

A retrospective case series by Morningstar et al.³³ followed the results of 22 idiopathic scoliosis patients selected consecutively at three different U.S. chiropractic clinics. After a maximum of six weeks of treatment using The Pettibon System, an average 17° reduction in Cobb angle measurements resulted. Although long-term follow up was not recorded for this study, it does provide hope for an alternative to surgical intervention.

Conclusion

The Pettibon System is a conservative treatment approach based upon basic anatomical and physiological processes to correct the structure of the spine. There is little doubt, according to the literature, that postural and spinal problems play a major role in the United States, with a large portion of health care spending devoted to musculoskeletal treatment annually.⁶ Therefore, it is appropriate to evaluate both the clinical effectiveness and cost effectiveness of any treatment option. Future studies should also compare the cost of treatment for The Pettibon System to other treatments using the same outcome measures.

The advantages of The Pettibon System over other postural treatment methods center on the utilization of neurophysiology to correct and maintain postural control. Since posture is under a well-developed network of reflexes, any system recruiting these postural reflexes to aid in spine and posture correction inevitably addresses more than just the mechanical components. The effects of The Pettibon System on other

physiological systems are currently being explored. Randomized clinical outcome trials are also being designed and conducted.

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