ORIGINAL RESEARCH

Improvement in Forward Head Posture, Cervical Lordosis, and Pulmonary Function with Chiropractic Care, Anterior Head Weighting and Whole Body Vibration: A Retrospective Study

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Abstract

Objective: A retrospective study was conducted on 11 patients in a private office setting to assess the influence that Pettibon System chiropractic adjustments and rehabilitation procedures would have on cervical lordosis, forward head posture, and pulmonary function.

Clinical Features: Cardiorespiratory activity is heavily influenced by posture and body movements. Abnormal posture of the head and neck, a commonly associated finding with vertebral subluxation, significantly influences respiration, oxygenation, and sympathetic function. Posture plays a critical role in the homeostasis of autonomic function such that when posture is optimized, not only is breathing also optimized but other visceral and somatic functions are seen to improve.

Intervention and Outcomes: Subjects were evaluated for postural abnormalities with lateral cervical radiographic films and pulmonary function through spirometric indices which measured forced vital capacity (FVC) and peak expiratory flow (PEF). Subjects received an initial exam that included a lateral cervical radiographic film and a spirometry measurement and then a second exam for both of these parameters at the completion of 3-6 months of care. The subjects showed a significant increase in cervical lordosis ($P < 0.001$), reduction in forward head posture ($P < 0.001$), improved Forced Vital Capacity ($P = 0.001$), and improved Peak Expiratory Flow ($P = 0.001$).

Conclusions: The results of this study indicate that Pettibon analysis and specific adjustments along with a postural correction protocol using anterior head weights, a posture strap, and Whole Body Vibration improved cervical lordosis, forward head posture and pulmonary function.

Key Terms: *Cervical lordosis, forward head posture, Pettibon, pulmonary function, spirometry, vertebral subluxation, chiropractic*

Introduction

Cardio respiratory activity has been shown to be heavily influenced by posture and body movements. Lenon, et al,[1] theorized that abnormal posture of the head and neck significantly influences respiration, oxygenation, and sympathetic function. They state that homeostasis of autonomic function are intimately related with posture such that when postural efficiency is optimized, not only is breathing also optimized, but other visceral and somatic functions are also seen to improve. On the other hand,

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inefficient posture and breathing habits lead to poor health status, and eventually to pathological dysfunction. Thus it can be inferred that there is an association between maximal posture, breathing, and overall health.

There are many factors that work in synchrony to produce posture and respiratory activity. The labyrinthine/vestibular system is generally thought to be the primary control unit of postural adaptations. Arshlan, et al, showed that vestibular inputs to the brainstem respiratory modulating centers are elicited as the head changes position in space. Thus, they suggested that vestibular inputs not only signal postural changes but they contribute to the control of breathing and oxygenation.[2] Ayres showed that asthmatic patients have a direct correlation between change in posture and change in vagal tone.[3] This would indicate a reflexive response on cardiorespiratory activity.

Several studies have documented the role of neck muscle afferent stimulation on the autonomic control centers in the medulla[1,4,5] Edwards, etc. showed the first direct evidence of a monosynaptic projection from the Intermediate nucleus of the medulla (InM) to the Nucleus Tractus Solitarius (NTS) through which proprioceptive neck sensory afferents may influence cardiorespiratory variables.[5] This group also theorized that the suboccipital muscle group was the primary mediator of the cervico-sympathetic reflex due to its heavy concentration of muscle spindles in comparison to the rest of the paraspinal musculature.[5]

Postural abnormalities are a distinguishing factor in the vertebral subluxation complex[6] that has been linked to abnormal sensory input and neuroplastic changes in the brainstem centers.[7,8] Chiropractic adjustments have been shown through various studies to positively modulate both postural distortions[9-13], sensorimotor integration[7,8] and cardiorespiratory functions.[14-19] Miller et al, highlighted two major segmental levels; the upper cervical (C0-C2) region and the mid-upper thoracic (T1-6) region, both of which are involved in heart and lung function.[16] Of primary importance is the upper cervical spine, which is associated with postural control.

Knutson demonstrated that upper cervical adjustments have been shown to cause immediate reductions in postural distortions and blood pressure.[18] This is theorized to be due to activation of high threshold mechanoreceptors in the joint capsule leading to an alteration in length of the suboccipital muscles. This process causes a resetting of activity in the muscle spindle Ia afferent processing.[7] The direct connection from the neck afferents to the InM/NTS makes the suboccipital muscle group the ideal position to mediate cardiorespiratory changes.[5]

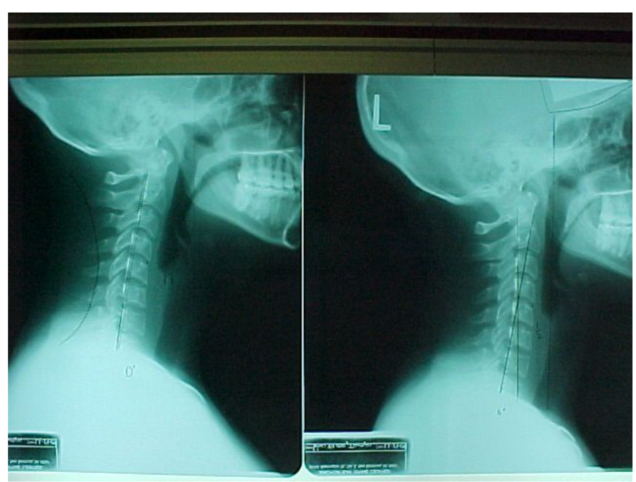
A preliminary study suggests that anterior head weighting alone, as well as coupled with chiropractic manipulation, has been effective at improving cervical lordosis and forward head posture.[9, 20] Since proper respiratory function is critical in human health, non-invasive modalities that can improve respiratory function should be examined more closely. In this report, we analyze the outcomes of 11 patients treated with chiropractic manipulation and anterior head weighting to determine if this treatment may be associated with improved pulmonary function.

Methods

A retrospective review of patient charts was performed at a single spine clinic in Grand Blanc, MI, USA. Patient charts were included if they met the following criteria: Patients were 18 years of age or older, care was initiated and completed within a period of 6 months from June 2007 thru December 2007, they received a set of initial and post-treatment radiographs of the cervical spine, and spirometry, peak expiratory flow, and cervical radiographic measurements of cervical lordosis and forward head posture were among the outcome assessments used for that patient. Patients were excluded if they presented with any of the following: history of chronic pulmonary disease, advanced cervical spine degeneration, cervical spine arthrodesis, cervical kyphosis, or acute cervical disc herniation. Using the above criteria, a total of 11 patients were selected for analysis.

All radiographic films were taken with patient seated and according to the Pettibon protocol[21] for accuracy. Additionally, the criteria for measuring cervical lordosis on radiographic films followed the Pettibon protocol. Lines were drawn on the lateral cervical film with a line off of the posterior vertebral body margins of the 2nd and 7th cervical vertebrae. A measurement was taken where the 2 lines intersected and as recorded as the subject's cervical lordosis. According to Kapandji[22], the normal cervical curve should measure 45 degrees. The forward head posture was analyzed with a vertical gravity line from the sella turcica, which represents the center mass of the skull. According to Kapandji[22], this line should intersect the C4-5 interspace. A measurement was taken between the gravity line and the C4-5 interspace and was recorded as the subject's forward head posture. Examples of the pre-post radiographic films are shown in Figure 1.

Figure 1. Pre & Post Treatment X-Rays



Spirometric measurements were taken with a Buhl spirometer and an ASSESS Full Range Peak Flow Meter. Both Forced Vital Capacity (FVC) and Peak Expiratory Flow (PEF) were measured and recorded. A test was taken in the initial pre-treatment exam and then another test was taken on their final post-treatment exam. Instructions before each test were as follows:

- Breathe in as deeply as possible.
- Blow into the instrument's mouthpiece as hard and fast as possible.
- Repeat the test 3 times
- The best score of the 3 attempts was recorded.

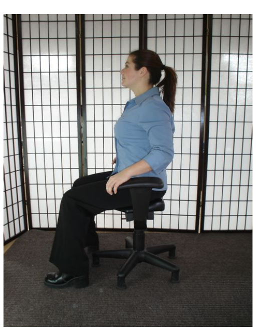
All patients in this study were treated using the Pettibon System adjustment and rehabilitation procedures.[23] The adjusting procedures included a –Z axis drop (a device used to perform a skull flexion adjustment when the skull does not flex properly on atlas), a Y axis traction adjustment applied bilaterally to the cervical spine to remove angular misalignments, an anterior thoracic adjustment used to mobilize the cervico-thoracic region, and a percussive instrument used to mobilize all the cervical spine joints individually. The total number of clinic visits varied for each patient. However, all patients began and completed treatment within the same six month period in 2007.

Patients were evaluated for vertebral subluxation at each clinic visit via postural exam, range-of-motion testing, and supine leg checks. If the exams warranted, patients were adjusted according to their exam findings. Patients were not necessarily adjusted at each office visit if their exams were negative. However, at each and every office visit, patients performed postural neuromuscular re-education.

Rehabilitation exercises included a repetitive traction device, supine positional spinal traction using high-density foam blocks, a wobble chair exercise, and an anterior headweight and posture strap. All the equipment was designed by Pettibon.[23] An illustration of these devices is provided in Figure 2a-d.

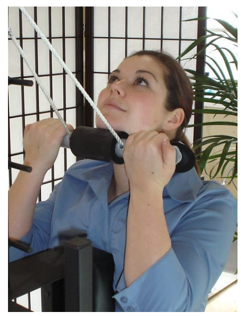
Figure 2a. Head Weighting Exercise

Figure 2b. Wobble Chair Exercise



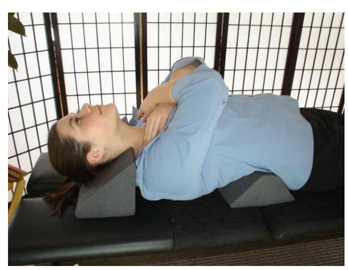
Patients wore the head weights for 10 minutes while standing on a vibration platform set at 25 Hz and 1-2mm amplitude at each office visit. This procedure was done immediately after they were checked for the presence of vertebral subluxation and adjusted accordingly. Each patient was also required to take the head weighting equipment home and instructed to wear it daily for 10 minutes while walking around their homes. In addition, they were taught how to use the cervical traction device, the wobble chair, and the high-density foam blocks. They spent 2 minutes on the cervical traction and 5 minutes on the wobble board doing range of motion exercises on each office visit. They were also told to use the cervical traction device 3x a day for about 1 minute each time at their house and to lie on the foam blocks 20 minutes before bed These recommendations served as an effort to minimize the amount of necessary office visits.

Figure 2c. Cervical Traction



Patients' treatment plans were determined by the severity of their functional and radiographic abnormalities. For example, patients with a complete loss of cervical lordosis or marked loss of cervical range of motion had longer treatment plans than patients with hypolordosis or moderate ROM reductions. For our hypothesis, we compared the results before and after treatment for spirometry, cervical radiographic measures of lordosis and forward head posture, and peak expiratory flow. initial exam.

Figure 2d. High Density Foam Blocks



Results

All patients completed their respective treatments without incident. Patient treatment plans ranged from 18 clinic visits to 41 clinic visits within a 3-6 month time period. Patients ranged in age from 19-47 with 8 females and 3 males. A breakdown of patient data is provided in Table 1.

Statistical analysis was performed on our data to determine a correlation between any of the variables. More specifically, we wanted to find out whether increasing the cervical lordosis and/or reducing forward head posture would result in improved respiratory measurements. Using Microsoft Excel data analysis, paired sample t-tests were performed for statistical analysis. Table 2 shows the results of our statistical analysis.

This study utilized the recommended standard ($p < .05$) for statistical significance within biological sciences. There was a statistically significant increase in cervical lordosis ($p < 0.001$), a decrease in forward head posture ($p < 0.001$), increased spirometry ($p = 0.0014$), and increased peak expiratory flow ($p < 0.001$).

Discussion

Spirometry is the gold standard instrument of choice to measure pulmonary function. Forced Vital Capacity (FVC) is the maximal volume of air exhaled during forced expiration and FEV1 is the maximal amount of air forced out in one second. These two measurements are considered an objective assessment of obstructive disorders and other restrictive pulmonary pathologies. Peak Expiratory Flow (PEF) is the speed of the air moving out of the lungs at the beginning of the expiration. Typical readings are higher in healthy patients and lower when the airways are constricted. Changes in recorded values allow patients and doctors to determine lung functionality.

Factors that can lead to a reduction in FVC include: 1) a collapsed airway which traps air in the alveoli, 2) decreased elasticity of the lung tissue lessening the subject's ability to exhale, 3) bullae and blebs in emphysematous lungs infringing upon the volume of functional alveoli thus decreasing the volume of exhalation, 4) subject discomfort after prolonged exhalation due to hypoxemia or other causes which result in inhalation before exhalation is completed. Normal ranges for spirometry have been shown to vary depending on the patient's height, weight, age, sex, and racial or ethnic background. Predicted values for lung volumes may be inaccurate in very tall patients or patients with missing extremities. FEV1 and FVC are greater in whites compared with blacks and Asians. In addition, it is well-known that FVC and VC values vary with the position of the patient upon examination.[24]

This study may shed some insight as to the effects of cervical hypolordosis and forward head posture on pulmonary function. All the subjects in this study experienced an increase in cervical lordosis and a decrease in forward head posture as measured by radiographic films along with an increase in pulmonary function as measured through spirometry and peak expiratory flow.

Since chiropractic adjustments have been shown to be largely unsuccessful at correcting spinal curves[25], the rehabilitative procedures are integral to the study results. Several case reports in the chiropractic literature have demonstrated positive changes in cervical lordosis and forward head posture as a result of Pettibon chiropractic care.[10,11] In addition, the use of anterior head weighting alone or in conjunction with spinal manipulations have demonstrated changes in cervical lordosis and forward head posture.[9,20]

Several studies have also shown improvement in pulmonary function associated with specific chiropractic care.[15,19] This is the first study, to our knowledge, to look at what affect these changes in spinal positioning may have on lung function.

The subjects in this study were instructed to perform a specific protocol of home care that consisted of walking for 10 minutes with an anterior head weight and posture strap daily. This was prescribed in order to reinforce the adjustments and strengthening exercises that were performed on office visits. Typically, a home exercise daily journal is utilized to ensure accurate records and monitor compliancy. This was not done in the study and therefore we are unsure as to the effect compliance or incompliance had on our results.

Whole body vibration (WBV) was utilized in this study to augment suboccipital muscle adaptations and improve posture Several studies have demonstrated enhanced neuromuscular motor unit recruitment patterns and resulting strength increases with the use of whole body vibration.[26-29] Hazell, et al[26], showed an increase in EMG firing patterns and strength in both upper and lower body musculature with the use of whole body vibration. According to Rittweger et al[27], oxygen consumption in active muscle increases linearly in vibration frequencies between 18-34 Hz. The same authors assume that neuromuscular recruitment patterns are maximized between this range of frequencies as well. Due to the supporting literature, Pettibon technique uses WBV at the set frequency of 25Hz as a standard part its postural correction protocol.

Due to the physiological adaptations that WBV has on the neuromuscular system, it is possible that this modality had a powerful effect on the results of the study. We are unsure of whether the positive effects of the study are due to the specific Pettibon adjustments and posture correction protocol, the WBV, or a combination of the two.

The reduction of forward head posture and enhancement of the cervical lordosis would most likely have a positive effect on the length tension relationship of the various suboccipital muscles. This effect would optimize the afferent input into the brain from these structures. Based on the intimate relationship between the cervical afferents and the brain centers governing autonomic function, optimizing the afferent input of the suboccipital muscles may have major implications on the homeostatic control centers of the brain. Therefore, the results of this study suggest a possible link between neutral head posture & the resulting tone of the suboccipital muscle group and the brainstem centers that govern pulmonary function. More research is necessary to validate this theory and future studies should be designed to test this relationship in an experimental design with an appropriate control group.

Conclusion

The presence of abnormal posture of the head and neck, a commonly associated finding with vertebral subluxation complex, may considerably influence respiration, oxygenation, and sympathetic function The results of this study showed that Pettibon spinal analysis and specific adjustments along with a postural correction protocol using anterior head weights, a posture strap, and WBV significantly improved cervical lordosis, forward head posture and pulmonary function. Future studies should examine further the relationship between chiropractic adjustments, posture correction, and pulmonary function.

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Table1.

Patient	Gender	PreCerv	PostCerv	PreFHP	PostFHP	PreSpiro	PostSpiro	PrePEF	PostPEF	Age
1	F	12	18	1.25	0.63	2600	3100	440	480	26
2	F	8	22	1	0.63	2200	2700	360	470	31
3	F	23	36	1.63	1	3000	3400	460	500	19
4	M	19	22	1.13	0.25	3900	4000	280	460	44
5	F	15	26	1.75	1	2500	4100	620	630	22
6	F	31	33	1	0.5	2900	3300	310	400	37
7	M	35	35	2	1.13	2900	3100	260	410	21
8	M	20	29	1.25	0	2300	3800	390	580	23
9	F	24	41	1.38	0.75	2700	3000	450	470	51
10	F	18	35	1.5	0.88	2600	3400	510	630	24
11	F	21	27	1.13	0.25	3300	3600	400	440	35

Cerv = Cervical lordosis (degrees)
FHP = Forward head posture (inches)
Spiro = Spirometry (cc)
PEF = Peak expiratory flow (L/min)

Table 2a

Lateral Cervical Radiographic Measurements t-Test: Paired Two Sample for Means	
Mean	20.54545455
Variance	60.67272727
Observations	11
Pearson Correlation	0.683130846
Hypothesized Mean Difference	0
Df	10
t Stat	-4.945963739
P(T<=t) one-tail	0.000291001
t Critical one-tail	1.812461102
P(T<=t) two-tail	0.000582003
t Critical two-tail	2.228138842

Table2b

Forward Head Posture Radiographic Measurements t-Test: Paired Two Sample for Means	
Mean	1.365454545
Variance	0.104347273
Observations	11
Pearson Correlation	0.765119471
Hypothesized Mean Difference	0
Df	10
t Stat	10.17462617
P(T<=t) one-tail	6.78009E-07
t Critical one-tail	1.812461102
P(T<=t) two-tail	1.35602E-06
t Critical two-tail	2.228138842

Table 2c

Spirometry Testing t-Test: Paired Two Sample for Means	
Mean	2809.090909
Variance	230909.0909
Observations	11
Pearson Correlation	0.396967734
Hypothesized Mean Difference	0
Df	10
	-
t Stat	3.948487202
P(T<=t) one-tail	0.001368491
t Critical one-tail	1.812461102
P(T<=t) two-tail	0.002736982

Table 2d

Peak Expiratory Flow Measurement t-Test: Paired Two Sample for Means	
Mean	407.2727273
Variance	11141.81818
Observations	11
Pearson Correlation	0.790812197
Hypothesized Mean Difference	0
df	10
	-
t Stat	4.616902584
P(T<=t) one-tail	0.000477549
t Critical one-tail	1.812461102
P(T<=t) two-tail	0.000955098
t Critical two-tail	2.228138842