ORIGINAL RESEARCH

Improvement in Radiographic Measurements, Posture, Pain & Quality of Life in Non-migraine Headache Patients Undergoing Upper Cervical Chiropractic Care: A Retrospective Practice Based Study

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ABSTRACT

Background: There is research supporting nociceptive structures in the cervical spine as a common origin for symptoms meeting International Headache Society diagnostic criteria for tension-type headache and cervicogenic headache. The potential to screen non-migraine headache subjects for referral based on posture, and to have that referral meet with a high level of success, is important to health care and to headache research.

Objectives: To determine if signs of postural imbalance and X-rays provide measurable indicators of cervical disarrangement related to non-migraine headaches and to determine the effectiveness in everyday practice of manual vectored adjustment of the atlas for attenuation of non-migraine headache pain intensity.

Methods: Progression of patients with non-migraine headache following manual, vectored-adjustment of the atlas was assessed by and correlated with pre- to post- adjustment changes in measurements from cervical radiographs, wellness and pain scale instruments, and load and non-load bearing modes of posture. Time-series analysis of VAS scores on patients who were adjusted once is fit to an exponential decay curve.

Results: There was statistically significant improvement in postural measurement, X-ray measurements, and in all wellness categories from pre-treatment to post-treatment. Time series analysis of the visual analog pain scale assessments showed a significant reduction in pain intensity within two weeks of treatment for those who received only a single treatment and that the pain intensity for the single-treatment group decreased by approximately 75 percent over the study period.

Conclusion: Correction of the atlas subluxation complex using National Upper Cervical Chiropractic Association (NUCCA) protocol may be a possible analgesic for non-migraine-especially cervicogenic- headache.

Key Words: *non-migraine headache, cervicogenic headache, tension headache, SF-36 questionnaire, VAS pain assessment, supine leg length alignment asymmetry, contractured leg, atlas laterality, atlas, C-1, vectored manipulation, subluxation, adjustment, NUCCA Technique, practice based research.*

Introduction

In 1994, the International Association for the Study of Pain (ISAP) accepted the term cervicogenic headache into its taxonomy, which defines headache conditions by their symptoms.[1] An obligatory symptom for cervicogenic headache is unilateral headache of fluctuating intensity increased by head movement, while associated symptoms may include arm and shoulder pain and blurred vision.[2,3] In the classification of headaches by the International Headache Society for both Category 2 tension-type headache, and Category 11.2.1 cervicogenic headache (1987), there is research supporting cervical involvement as a common origin.[4] It has been hypothesized by some that cervicogenic headaches originate from nociceptive structures in the cervical

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spine and are "reaction patterns."[2,5] It is widely recognized that "dysfunctions of the upper cervical apophysial joints play an important role in regionally adjacent syndromes like headaches and also in relation to generalized dysfunctions of the entire human locomotor system."[6] Reliable diagnostics must be based on the patient's history, clinical findings, and relevant measurements. In this retrospective study, a single general practitioner diagnosed and referred 239 patients for possible treatment by manual vectored C-1 adjustment to a single National Upper Cervical Chiropractic Association (NUCCA) board-certified doctor. We report here the observations resulting from correction of the atlas subluxation complex on a subset of these patients with non-migraine headache.

Methods

Patients

Of the original 239 cases (referred between 1995-1997), 47 (29 female;18 male) of the 50 patients who were diagnosed as having non-migraine headache symptoms met the age range criteria of 18-65 years used in this study. The average age of the study population was 41.4 (SD, 11.3) years, while the average duration, or chronicity, of their headache symptoms was 9.4 (SD, 10.7) years. Records of the upper cervical chiropractor contained the patient's age, gender, symptoms, duration of symptoms defined by the referring physician, medical diagnosis, postural and x-ray measurements, visual analog pain scale data (VAS) to measure the average intensity of each of the major symptoms, short form 36 questionnaire (SF-36) results to evaluate the overall health related to quality of life, and extensive comments from the caregiver. Each of these metrics is described in greater detail below. All available data was used and reported. Records of the NUCCA chiropractor also indicate two major symptoms for each subject, with non-migraine headache being one symptom in all cases, cervical pain being the second most frequent (36%) symptom, followed by shoulder pain (15%) and vertigo/vision problems (11%).

Postural Measurements

The primary postural measurement is the functional or physiologic leg-length inequality (LLI). The physiologic/functional LLI is not an actual shortening of leg length and can be better described as leg length alignment asymmetry.[7] The LLI is determined by placing the patient in a supine, non load-bearing position and measuring the difference, if any, between the apparent lengths of the extended legs. The shorter of the two legs is sometimes known as the contractured leg. The LLI apparently results from over–innervation, or spastic contracture, of the extensor musculature.[8] There is agreement in the literature that any LLI of three-eights of an inch or more is both easily measurable and is correlated to the existence of C-1 positional disarrangement.[9]

The secondary postural measurement, pelvic tilt or Anatometer frontal plane (AFP), is taken using an Anatometer. The Anatometer is an instrument that measures and records postural distortion with the subject in a load-bearing, standing position. Stationary standing posture is usually defined in relation to a vertical line through the body's center of gravity that passes through most of the lumbar vertebral bodies and anterior to the thoracic vertebrae.[10] Seven postural measurements can be determined using an unmodified Anatometer. These include bilateral weight distribution, rotation of the pelvis in the transverse plane, tilt of the pelvis in the frontal plane, and angulation or tilt of the upper quarter of the body from the vertical.[11] In this study, only the tilt of the pelvis in the frontal plane was available for use. The pelvic tilt is the measured angular difference in degrees in the frontal plane between the oblique and the normal horizontal pelvic position. Both of these postural measurements, one in a load-bearing position and one not in a load-bearing position, are indicative of C-1 positional disarrangement, which is considered pathological by the upper cervical specialist.

All 47 referred subjects had postural distortion as measured by supine leg check; all 47 subjects had an Anatometer measurement indicating pelvic tilt. All 239 cases were referred to the upper cervical specialist by the medical practitioner based on the determination that LLI was present.

Radiographic Measurements

Based on the indication from the postural measurements that C-1 positional disarrangement was present, X-rays were taken on the new patient. The first X-ray taken is a lateral cervical view. Positional disarrangement of the cervical vertebrae in this study can be seen in both the " exaggerated Town's" view, referred to here as the nasium view, and Reverse Waters view, referred to here as vertex view. The nasium and vertex views are used to determine atlas laterality and atlas rotation, respectively. These two measurements are measures of C-1 positional disarrangement and are used in the calculation of the direction of the vectored adjustic force.

Atlas laterality (ATL) is the angular frontal plane component of the positional disarrangement of C-1 resulting from an abnormal rotational movement or side slip of C-1 about the condyles of occiput and is measured off the nasium X-ray view. It is computed as the complement of the acute angle formed by the intersection of the central skull line, a line bisecting the skull and separating the skull into left and right halves, and the atlas plane line, a line below the posterior arch of the atlas. Atlas rotation is the transverse plane component of the positional disarrangement of C-1 resulting from abnormal rotational movement about the condyles of occiput and is measured off the vertex view.[12] Analysis of the upper cervical X-ray technique procedure used has been found to be both inter-examiner and intra-examiner reliable for both atlas laterality and atlas rotation and has been used in other studies.[13-15]

Forty-seven ATL measurements were obtained from x-ray films taken pre-treatment and another forty-seven ATL measurements were obtained from outcome assessment x-rays taken immediately after the patient's first treatment. Twelve patients received more than one treatment based on the existence of measured postural distortion within the 120-day study period; these 12 patients averaged 2.66 treatments. The same vector for a given patient was used in their additional treatment if the postural patterns were the "same," that is, if the LLI of a given patient had the same leg contractured as on the initial visit and the Anatometer patterns were similar. The modus operandi of the vectored correction technique would suggest at least an additional post-nasium X-ray if the postural patterns had changed. If only the degree of a given pattern changed, then an additional X-ray would not be indicated by the normal standards of practice. In these 12 patients, only the degree of the pattern changed and therefore no additional X-rays were needed.[16] All 47 (239) subjects had ATL of three-quarters of a degree or more. Only this X-ray parameter was easily accessible for use in this study. It should be noted that functional LLI is always present when the cervical nasium radiograph indicates three-quarters of a degree or more of atlas laterality and thus is the primary screening measurement for determining the existence of C1 positional disarrangement by the NUCCA chiropractor.

All data was taken from the records of a single NUCCA board certified chiropractor (second author) who has an established practice based research (PBR) office. Using a NUCCA board - certified doctor addressed the difficulty in placing patients for plane radiographs, analyzing plane radiographs, and placing the patients in side posture with the correct head position for treatment. The authors agree with Mayer et al. that functional radiology is difficult.[17] This study also required that the NUCCA doctor be able to consistently deliver an accurate vectored manipulation resulting in at least 80% or better reduction in all postural measurements and proportionately in all cervical disarrangement factors measured from x-rays. Also, the practice had to have an informed "consent for research" process used routinely on all patients. [University of Toledo Biomedical IRB # 206-174 approval for "consent of research form" and for use of data for publication]

Patient Responses: Visual Analog Pain Scale

The visual analog pain scale (VAS) is a widely used psychometric pain assessment tool that is used to meaningfully quantify changes in pain intensity and is often used to measure differences in the potency and efficacy of various analgesics.[18] The VAS was used in this study to rate each patient's perceived level of pain on a 10 cm line. A 10 cm response corresponds to "the worst pain imaginable" and a 0 cm response corresponds to "no pain." Patients rated their perceived level of pain on initial presentment for two symptoms and again on each subsequent office visit before seeing the chiropractor.

Due to the lack of a formal control group inherent in many retrospective studies, it is often difficult to conceptually gauge the significance of the results. To help counter this difficulty, data from four other headache studies was used to construct a literature baseline for the VAS analysis.[19-22] In these four studies, both migraine and non-migraine groups were considered; however, only non-migraine groups from these studies were used to construct a literature baseline.

Approximately half of the 291 subjects in the literature baseline group were diagnosed with tension-type headache, while the other half was diagnosed with cervicogenic headaches. In comparison to the pre-treatment baseline for the patients in this study, none of the demographic features of the literature baseline group were significantly different. Both groups were approximately two-thirds female and one-third male, both groups have similar age distributions with means of approximately 41 years of age, and both groups have similar perceived headache intensities as measured on the VAS scale.

Patient Responses: Short Form 36 Questionnaire

Medical Outcome's Short Form 36 (SF-36) questionnaire is a common metric to assess health-related quality of life. The SF-36 is composed of 36 questions designed to measure eight key areas related to health and quality of life by asking patients to recall their experiences within the previous four weeks.

Four of the eight categories, physical function, bodily pain, role physical, and general health, are used to examine specific qualities that define physical well-being. The other four categories, vitality, social function, role emotional, and mental health, are designed to assess different attributes of mental well-being. The SF-36 questionnaire was first administered to patients prior to initial treatment and was repeated within 90 to 120 days.

One of the key advantages of using the SF-36 is the availability of normative estimates for the 1998 U.S. population using a sample size of 5038 individuals. For all eight categories, the 1998 U.S. norms were re-centered so that each category has a mean of 50 and a standard deviation of 10. Scores higher than the normative values indicate a higher level of wellness, while lower scores indicate a lower level of wellness. These estimates, along with norm-based scoring algorithms, make the results from SF-36 measurement directly comparable to population estimates. In addition to normative estimates, a literature control group was compiled from SF-36 results presented in a study by van Suijlekom et al.[23] Both the literature control group and treatment group had approximately a 2:1 female-to-male ratio as well as similar age distributions with means of 44.63 years (SD, 12.91) and 41.38 years (SD, 11.29), respectively. Statistics on the chronicity of the headaches were unavailable for the literature control group. Both wellness and pain assessments were correlated to changes in postural and x-ray measurements and compared with data from other headache studies.

Results

Analysis of Postural Distortion Measurements and Radiographic Measurement

Table 1 shows the pre-treatment and post-treatment measurements of atlas laterality, leg length inequality, and pelvic tilt. Measurements of LLI differences in inches, pelvic tilt angular postural distortion in degrees, and ATL from the radiograph in degrees show a statistically significant change towards "normal" between the pre- and post- treatment.

Analysis of Visual Analog Pain Scale

Table 2 provides comparisons between the literature baseline and the pre-treatment baseline groups of non-migraine headache subjects. The sample population in this study was found to be similar to sample populations used in other studies containing non-migraine headache subjects with respect to both demographics and visual analog pain scale assessments. There was no significant statistical difference between groups by either age or VAS scores. Both comparison groups had roughly a 2:1 ratio of female to male. Chronicity was not available for groups that make up the literature baseline.

Table 3 shows the VAS results for the primary symptom of non-migraine headache by utilizing paired and 2-sample t-tests comparing the pre-treatment baseline and post-treatment group and the literature baseline and post-treatment group, respectively. The VAS scores reported by the post-treatment group indicate a statistically significant reduction in perceived headache pain intensity post-treatment.

Time Series Analysis of Visual Analog Pain Scale

Of the forty-seven records examined in this study, thirty-five of the individuals received only one treatment. These 35 patients had a total of 218 office visits (mean = 6.2 visits/patient) within the study period. A time series analysis was performed on the VAS scores related to headache pain of these thirty-five patients using VAS records from the first 150 days of treatment. The VAS scores were first normalized with respect to their score recorded on the day of their first treatment and each subsequent VAS score is represented as a percentage of their initial VAS score. A moving average on the normalized VAS scores was performed to eliminate high-frequency variance from the data. To ensure that the low-frequency trends were not influenced by the moving average, a sufficiently small period of about 5.05% of the total number of data points was used. A nonlinear regression technique was used to fit a decaying exponential function (base "e") of the form $y = a\exp(-bt)+c$ to the data. As can be seen from Table 4, the best-fit regression line explains approximately 90% of the variance in the moving average.

From the exponential expression, two important parameters were extracted, the time constant and the steady-state value of the decay. The time constant is defined as the reciprocal of the coefficient in the exponential term of the model ($\tau = 1/b$) and is a measure of the rate of decay in days. By definition, when one time constant has passed, the variable described by the model has decayed to 63.2% of its initial value. Since the data is normalized to the patients' initial VAS score, one time constant away from the start of their treatment marks a 36.8% reduction in perceived pain according to the VAS scale. Our model estimated the time constant to be approximately 14 days. The other parameter, the steady-state value (c), is an estimation of the level of decay given an infinite duration of time. The model predicts that there is ultimately a 75% reduction in the VAS score. Both parameters were estimated with an asymptotic 95% confidence interval. The confidence intervals are denoted as asymptotic because a linear approximation was used for the nonlinear fit, meaning that the given confidence is not exact. Asymptotic estimations for nonlinear models are often overly conservative in their given range.

Analysis of Short Form 36 Questionnaire

In addition to SF-36 questionnaire data collected in this study, data was taken from a previous study conducted by van Suijlekom et al.[23] in which SF-36 data was collected from patients with cervicogenic (N=37) and tension-type headaches (N=42). The data was then normalized in order to make it directly comparable to the pre-treatment baseline, post-treatment, and normative estimates. This literature-based control is subsequently denoted as the literature baseline.

Results for physically-related and mentally-related categories are given in Figure 1 and 2, respectively. For all eight categories, patients showed statistically significant improvement after 90-120 days of treatment. All eight categorical measurements for the pre-treatment baseline results are significantly less than the normative estimates, while most of the post-treatment categorical measurements are not significantly different from normative estimates. In comparison to the literature baseline, the post-treatment results show significant improvement across all eight categories. These results indicate a significant improvement in the patients' health-related quality of life as measured by the SF-36 questionnaire. Furthermore, the results from the bodily pain category demonstrate significant improvement at the same confidence level as the VAS pain measurements.

Analysis of the VAS scores relating to the second set of major symptoms, those other than non-migraine headache pain, showed improvements similar to those observed by VAS scores relating to average headache intensity. However, since the SF-36 scores are not symptom-specific, the improvement in quality of life is confounded by multiple symptoms and cannot be solely attributed to the reduction of headache symptoms by the treatment. This study did not address that some patients may have coexisting headache disorders, possibly both cervicogenic- type and tension-type headaches.

Discussion

Various modalities for treatment of headache, including non-vectored cervical manipulation, have been around for many years.[24-27] Manual vectored forces used in this study are in the range of 30-100 Newtons and are characterized as having small velocity, impulse, and depth and producing small displacements. This implies that small increments of energy are being transferred indirectly into C-1 with the patient being unaware of C-1 movement. The authors believe this manual vectored approach to be the least invasive of all "manipulative" approaches because of the relatively small force magnitudes necessary to overcome the resistance of the cervical disarrangement, the control of the direction of the force, the ability to use the resistance of the cervical disarrangement to set the magnitude of the force needed for movement of C-1, and the potential to limit the frequency of intervention. The NUCCA chiropractor in this study (second author) typically administers only 1-3 interventions (triceps pulls) or contacts per treatment; this is unique among NUCCA board- certified doctors.

This study is different in many respects from previous studies: no manual palpation, no range of motion in flexion and extension, no large force, a vectored force, no blood work, and no mobilization, to name a few. Major review articles did not have literature overlapping the unique elements of this study even though the medical profession has been active in cervical spine research for at least fifty years.[28-34] To the author's knowledge this is the first study using pre-2000 data that used (1) both diagnosis and postural screening for LLI by a medical doctor for selecting a population with C-1 involvement and then referring the population to an upper cervical chiropractic specialist, (2) a time series analysis on the effects of a single specific orthogonal upper cervical treatment on any type of headache for more than a single patient, and (3) correlations of non-migraine headaches, which are believed to be cervicogenic, with posture, x-ray measurements, and standard pain and wellness instruments.

From a population of 239 patients, 50 were diagnosed with non-migraine headache and 47 met the normal literature age range of 18-65. The medical diagnosis of non-migraine headache all but eliminated the possibility of migraine without aura. We found that all 50 non-migraine headache patients had C-1 positional disarrangement based on meticulous cervical X-ray and patient positioning processes. The authors do not suggest that all non-migraine headache patients have postural asymmetries or C-1 disarrangement; we do suggest that if postural asymmetries do exist, then the probability is that patients diagnosed with non-migraine headaches have C-1 positional disarrangement.

In pain clinics, cervicogenic headache occurs in 33.8% of headache patients; this statistic when coupled with the second set of major symptoms and comments from the caregiver support the assumption that a significant fraction of the subjects experienced cervicogenic headaches.[35] However, the sheer prevalence of tension-type headache in the general population (78%) and the absence of a rigorous differential diagnosis by either the referring physician or the upper cervical chiropractor do not exclude the possibility that a small fraction of the subjects may have experienced a tension-type headache with bilateral complaints.[2,5,6] Literature supporting that non-vectored manipulation was more therapeutic to cervicogenic headache than to tension-type headache supports the supposition that the predominant group had cervicogenic headaches.[36] Misalignment of atlas determined from X-rays and head tilt and other postural distortions all strongly suggest a preponderance of cervicogenic headache.

Because the preponderance of the non-migraine headaches in this study appears to be cervicogenic, the authors suggest that C-1 positional disarrangement could be a sufficient reason to suspect cervicogenic headache in non-migraine headache subjects.

It should be noted that a significant fraction of all patients with C-1 disarrangement as determined by LLI have an "awkward head position." The body, including the head and neck, tries to compensate for being off the vertical by righting itself. It seems well established that C-1 disarrangement can be caused both superior and inferior to C-1. A recent study used malocclusion to induce a scoliotic curve at T1 "probability related to the consequential tilt of the first cervical vertebrae (C-1) which affects the tilt of adjacent vertebra, destabilizing the vertical alignment of the spine."[37] Instead of anterior lean of the upper quarter of a body in the sagittal plane, this study supports postural problems at the level of the pelvis in the frontal or coronal plane.

In this study, the geometry of X-ray tube, patient, and film distances translates three-quarters of a degree or more of atlas laterality into a corresponding 0.17 mm or more on the nasium plane radiograph. Whereas the preponderance of previous studies assesses the mobility or hypomobility of the intervertebral cervical joints in the sagittal plane as described by Mayer et al., the upper cervical measurement process used in this study was based on the frontal or coronal plane static view via a nasium X-ray to determine atlas side shift around the condyles of occiput. The upper cervical specialist who participated in this study has viewed well over forty thousand nasium X-rays in over fifty years of practice and has improved on all phases of the radiological examination including patient placement for X-rays, marking of patients for structure location, sophisticated patient shielding to lower patient dose, and development of internal measurements checks.

The authors are also aware, based on research by J.A. van Suijlekom, that the inclusion of an expert headache neurologist for differential diagnosis would be preferred.[5] The obligatory criterion for cervicogenic headache, unilateral headache of fluctuating intensity, was not recorded by the chiropractor and records from the medical doctor were not available. Most of the literature is confounded by multiple approaches and multiple skill levels.[5,38,39] In this retrospective study, information such as medication used, frequency of attacks, precipitating factors, and ameliorating factors were not available. Future research will involve a headache neurologist to diagnose the headache type and monitor the progress of the patients under treatment.

The purpose of this study was not to address possible physiological causes or etiology of non-migraine headache or to test current theories, but rather to provide an original approach that may suggest some possible avenues for headache research that may lead to a more robust etiology of C-1 involved headaches.[31,40-43] The 189 patients who were not diagnosed with non-migraine headaches all had postural LLI and had X-ray measured C-1 positional disarrangement and presented a variety of medically diagnosed symptoms such as sciatica, lumbar pain, TMJ, and migraine headache (n = 4). Almost all had approximately equivalent results with manual vectored adjustment at C-1. This suggests that the entire upper cervical process has a high degree of efficacy and usefulness not readily found in the literature and appears to suggest the involvement of the autonomic nervous system.[44] A recent study using the same protocol by the same NUCCA specialist shows achievement of arterial pressure goal in hypertensive patients.[45]

This retrospective study was performed on data collected through practice-based research. Practice based research (PBR) has many advantages and disadvantages. Of primary disadvantage is an absence of a control group and of "blinding". One cannot afford to give placebo "manipulations" resulting in patient complaints in practice. No insurance company would want to pay for a placebo manipulation. Few patients would want to be part of an experiment in which their time and money is considered wasted. At best one can only use studies from the literature to serve as the "non-treatment group".

Another consideration and potential problem in PBR is how to handle patient spacing if the number of patients with a given symptom is relatively small. Small for PBR may be more than adequate for designed experimentation. For example, the high-frequency variance observed before applying the moving average on the time series analysis could be attributed to the fact that the intervals between visits, and thus reported VAS scores, are irregular across the thirty five patients. It could also be a result of normalizing a wide variety of VAS scores to the same scale. Patients with extremely high initial VAS scores may best fit different exponential models from those with low initial VAS scores since they may report different relative reductions in pain levels.

It should be apparent that publication of PBR requires different literature criteria than traditional research. The only other reasonable way to directly make comparisons in PBR is to compare with other PBR results of the same or different technique. There is no way to know without double- blinding if these patients would have shown equivalent results had they not been adjusted.

One can, however, possibly begin to argue on the basis of the chronicity of headache symptoms of the patients before treatment that these observations are significant. When coupled with data from pre-treatment X-rays and outcome assessment X-rays and with both pre-treatment and post-treatment load-bearing and non-load bearing postural measurements (changes) being positively correlated, it seems unreasonable to not accept that biomechanical and neurological changes did take place. Certainly the authors do not believe that the subjects from this study somehow were talked into a lessening of pain (VAS) or an attitude change (SF-36). The authors do not believe that common biases such as regression to the mean, natural history of headache, placebo effect, and confirmation bias, have anything more than minimal effect and therefore do not compromise the external validity of the study findings.

Practice based research also has many advantages. PBR illustrates what is done in practice and in that sense it explains why chiropractors have patients and why they are able to build their practice. It is the continuous quality of care and its effectiveness that the most important critic- the patient himself- upon which the decision to remain under care is actually made. It is the basis of the demand by the public that provides chiropractic colleges a reason to exist.

The NUCCA modus operandi of manual vectored- adjustment utilizing both pre-adjustment X-rays taken on new patients for assessment of pathology and biomechanics and outcome assessment X-rays for establishing any future baseline is shared by other upper cervical techniques such as Orthospinology and Atlas Orthogonal. NUCCA however has been the leader not only in establishing the importance of body posture as evidenced by the development of the Anatometer but also in discovering, defining, and interpreting X-ray in- pattern and out-of-pattern biomechanical misalignments of the upper cervical spine. Both body- posture patterns and X-ray misalignment patterns have been found to persist in the absence of trauma if left uncorrected.[46]

The authors take issue with the purported behavior of editorial staffs in some chiropractic related/dominated publications which apparently reject studies or are at least less favorable to publication of these studies because they have used outcome assessment x-rays on new patients; certainly, as is the case in this study, if an IRB made up of more than a dozen medical doctors can approve outcome assessment x-rays and pre-treatment X-rays, then no editor should find X-rays to be a problem whether or not the study is retrospective. It is just such an X-ray protocol that shows that chiropractic can have more than a symptom-based outcome; it is just such a repeatable chiropractic protocol due in part because of X-rays that chiropractic should embrace the efforts.

Conclusions

Manual vectored adjustment of the atlas by an upper cervical chiropractic doctor using an orthogonally-based analysis system may be a possible analgesic for non-migraine headaches and may be the most appropriate single procedure in which to address cervicogenic headache. Leg-length inequality taken with the patient in a supine position may be the easiest postural measurement by which to address neurological insult to the C-1 area and also may be helpful in making a more robust differential diagnosis in future headache studies and in upper quarter conditions in general. The process of initial postural screening and diagnosis of non-migraine headache by the medical physician serving as the primary care provider leads, upon referral, to significant positive correlations with posture, x-ray measurements of both C-1 and cervical disarrangements involving other vertebra, and standard pain and wellness instruments.

The potential to successfully screen non-migraine headache subjects for referral based on posture and to have that referral meet with a high level of success is important to health care. The apparent effectiveness of a single treatment session using manual vectored adjustment at C-1 is provided by the time-series analysis of VAS measurement and provides a target for measuring the relative practice based effectiveness of the hundreds of other techniques. The authors believe that practice based research is the most reasonable way in which doctors can judge the effectiveness of what they do day in and day out. PBR will promote the advancement of chiropractic practice skills and increase the pool of inclusiveness.

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Table 1 — Comparison of Postural Measurements and Radiographic Positional Measurement

Postural Measurements	Pre-Treatment Baseline	Post-Treatment	P-value ($\mu_1 > \mu_2$)
N	47	47	-
Leg Length Diff. (in.)	0.82 ± 0.30	0.01 ± 0.09	< 0.001
Pelvic Tilt (deg.)	3.22 ± 1.45	0.14 ± 0.27	< 0.001
Atlas Laterality (deg.)	1.79 ± 1.10	0.28 ± 0.40	< 0.001

Table 2 — Comparison of Baseline Groups (VAS)

Feature	Literature Baseline(19-22)	Pre-Treatment Baseline	P-value ($\mu_1 \neq \mu_2$)
N	291	47	-
Female: Male	195:96	29:18	-
Age (yr)	40.97 ± 12.87	41.38 ± 11.29	NS
Chronicity (yr)	-	9.43 ± 10.74	-
VAS	5.57 ± 2.02	5.73 ± 2.37	NS

*NS = Not significant at 95% confidence level

Table 3 — Comparison of Post-Treatment VAS with Baseline Groups

Feature	Literature Baseline(19-22)	Pre-Treatment Baseline	Post-Treatment	P-value ($\mu_1 > \mu_2$)
N	291	47	47	-
VAS	5.57 ± 2.02	5.73 ± 2.37	1.26 ± 1.49	<0.001[*], <0.001[†]

*Post-Treatment Vs Literature Baseline [†]Post-Treatment Vs Pre-Treatment Baseline

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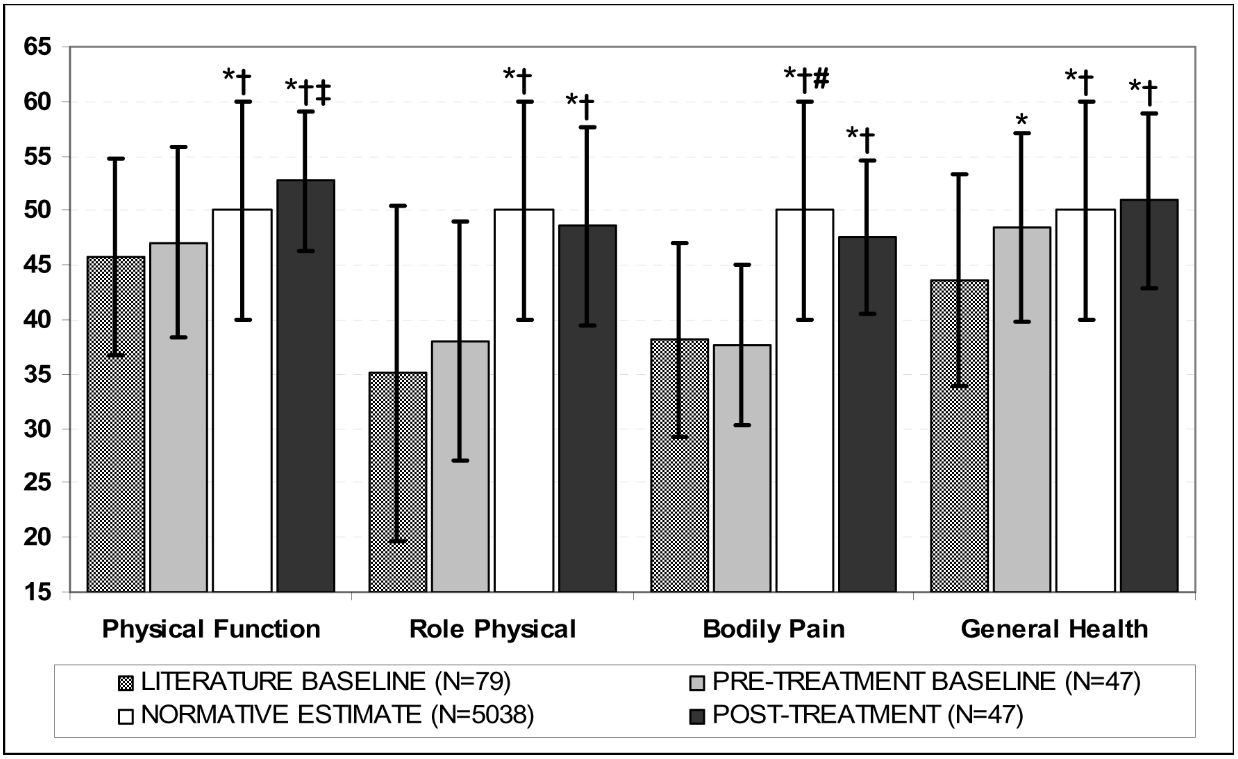
Table 4 — Time Series Analysis of VAS: Exponential Regression

Feature	Headache Group
N	35
Number of Applications	1
Number of Total Data Points	218
Averaging Period (%)	5.05
Analysis Duration (days)	154
Time Constant (days)	13.83
Asymptotic 95% C.I. (days)	(12.48, 15.50)
Steady State Value (%)	25.15
Asymptotic 95% C.I. (%)	(23.15, 27.16)
Coefficient of Determination (R^2)	0.90

Figure 1 — Comparison of the SF-36 Physical Categories



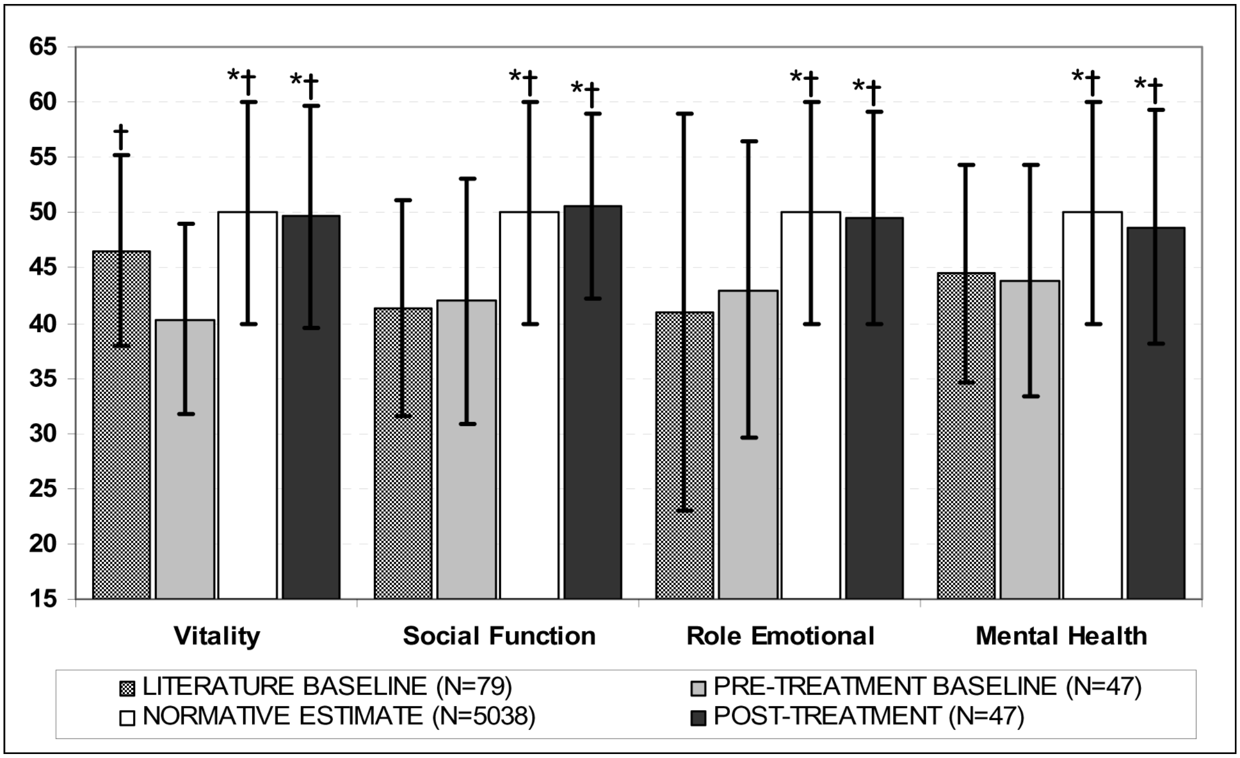
*Greater than literature baseline[23] (P<0.05)

†Greater than pre-treatment baseline (P<0.05)

‡Greater than normative estimate (P<0.05)

#Greater than post-treatment (P<0.05)

Figure 2 — Comparison of the SF-36 Mental Categories



*Greater than literature baseline[23] (P<0.05)

†Greater than pre-treatment baseline (P<0.05)

‡Greater than normative estimate (P<0.05)

#Greater than post-treatment (P<0.05)