

Conservative methods for reducing lateral translation postures of the head: A nonrandomized clinical control trial

Deed E. Harrison, DC; Rene Cailliet, MD; Joseph Betz, BS, DC; Jason W. Haas, DC; Donald D. Harrison, PhD, DC, MSE; Tadeusz J. Janik, PhD; Burt Holland, PhD

Private Practice, Elko, NV; Department of Rehabilitative Medicine, University of Southern California School of Medicine, Pacific Palisades, CA; Private Practice, Boise, ID; Private Practice, Windsor, CO; Biomechanics Laboratory, Universite du Quebec a Trois-Rivieres, Evanston, WY; CompMathRC, Huntsville, AL; Department of Statistics, Temple University, Philadelphia, PA

Abstract—Fifty-one retrospective, consecutive patients were compared to twenty-six prospective volunteer controls in a non-randomized clinical control trial. Both groups had chronic neck pain and lateral head translation posture. For treatment subjects, beginning and follow-up pain scales and anteroposterior (AP) cervical radiographs were obtained after 12.8 weeks of care (average of 37 visits), while the duration was a mean of 12 months for control subjects. Digitized radiographs were analyzed for Risser-Ferguson angles and a horizontal translation distance of C2 from a vertical line through T3. For treatment, patients received the Harrison mirror-image postural methods, which include mechanically assisted manipulation, opposite head posture exercise, and opposite head translation posture traction. While no significant differences were found in the control group subjects' pain scores and AP radiographic measurements, statistically significant improvements were observed in the treatment group subjects' pain scores and lateral translation displacements of C2 compared to T3 (pretrial score: 13.7 mm, posttrial score: 6.8 mm) and in angle measurements.

Key words: exercise, head posture, lateral translation, rehabilitation, traction, x-ray.

INTRODUCTION

Recent literature has shown that the cervical lordosis is an important clinical parameter [1-3]. The socioeco-

nomie costs for cervical spine disorders have been estimated in the tens of billions of dollars per year [4], and neck pain is estimated to affect 70 percent of individuals at some time in their lives [5]. Disorders of the soft tissues and structure of the cervical spine have been associated with cervical pain, thoracic pain, and headaches [4].

Previous studies have scrutinized these cervical spine disorders with clinical control trials to determine the efficacy of conservative treatment protocols with manipulation [4], mobilization [6,7], and pharmacological treatments with manipulation [8]. With regard to sagittal plane alterations (military neck, kyphosis, S-curves, etc.) of the normal lordosis, a recent clinical controlled trial that used manipulation and three-point bending extension traction reported improvements in chronic neck pain and a significant increase in the cervical lordosis [9].

Abbreviations: AP = anteroposterior, NDI = Neck Disability Index, NRS = numerical rating scale, SEM = standard error of measurement, SF-36 = Short Form 36.

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Address all correspondence to Donald D. Harrison, PhD, DC, MSE; P.O. Box 1590, Evanston, WY 82931-1590; 307-789-2088; fax: 307-789-2154; email: drcbp@idealspine.com.

Postural rotations (axial, lateral bending, flexion/extension), termed the traditional planes of motion, have been studied to the neglect of the postural translations. Perhaps the reported small vertebral translations have misled investigators to believe that postural translations are small also. However, Penning [10] and Harrison et al. [11] have shown that sagittal and coronal translational ranges of motion of the head can be several centimeters. Compared to the sagittal translations of the head, coronal head translations compared to the thoracic cage have been largely neglected in the biomedical literature, except for one study that reported the normal coupling patterns of this common clinical posture [11]. That study showed coronal translations (lateral head translations) create S-shaped configurations on anteroposterior (AP) cervical radiographs [11]. Those authors postulated that this posture could be created during traumatic events such as side-impact auto collisions [11].

We, the authors of this study, have retrospectively analyzed treatment subjects compared to prospective control subjects for this abnormal coronal head translation posture. We hypothesized that opposite postural translation traction, opposite postural exercise, and opposite mechanically assisted manipulation would create tension in the cervical spinal structures, resulting in postural and spinal correction. We further hypothesized that decreased pain outcomes would occur with the use of these methods.

METHODS

Fifty-one consecutive, retrospectively selected patients with chronic neck pain and lateral head translation posture (side shift) received Harrison mirror image methods, including a new type of lateral translation cervical traction. Subjects were included if they had chronic cervicogenic pain and their posture and AP cervical radiograph depicted coupling patterns associated with lateral head translation [11]. The coupling patterns for lateral head translation have been studied, and an S-shape was reported with upper thoracic and lower cervical (C5–T4) lateral flexions to the same side as the head movement and an opposite lateral flexion at C4 and above [11]. Also, the x-ray coupling patterns were compared to the subjects' postures to ensure the lateral head translation posture was present. We defined chronic cervicogenic pain as their first episode of pain greater than 3 months or multi-

ple occurrences. The average duration since onset of neck pain was 7.0 years.

Because, in the early 1980s, Harrison had originated categories of head, rib cage, and pelvic postures based on rotations and translations in three dimensions and originated opposite postural corrective procedures, termed "mirror-image methods" [12], we decided to use these procedures applied to the specific head posture of lateral translation. **Figure 1** illustrates lateral head translation posture.

We determined improvements in radiographic measurements by comparing an initial and follow-up (posttreatment) AP cervicothoracic radiographs, the follow-up obtained at a mean of 12.8 ± 3.3 weeks of care in the treatment group. Treatment group data were compared to a non-randomized prospective control group ($N = 26$) who also had chronic cervicogenic pain and lateral head translation



Figure 1.

This figure demonstrates the common, yet often neglected, lateral head translation posture (side shift). Note that the median-sagittal line of the face is right laterally translated compared to a vertical line through the episternal notch. The patient who presents with this posture may be completely unaware that he/she possesses it. Clinicians should notice that the head is shifted right compared to the thorax, with no noticeable amount of rotation or lateral flexion.

posture. In the control group subjects, who had no treatment intervention, follow-up AP cervicothoracic radiographs were obtained at an average of 50.4 weeks.

In addition to AP cervicothoracic radiographic measurements, all participants in both groups were evaluated carefully and completed a history that included (1) a pain drawing to elucidate the location of pain, (2) a numerical rating scale (NRS) on which patients rated their perceived pain intensity from 0 (no pain) to 10 (excruciating pain and bedridden), (3) self-reports of the frequency and duration of their pain, and (4) self-reports of the extent of perceived functional limitations due to their neck pain. This history was completed at the beginning and at follow-up. The NRS values were compared between the two groups.

Subjects were evaluated at a spine clinic in Elko, NV. Control subjects were volunteers who signed informed consents. All applicable laws for the use of human subjects in research were followed by our institutional review board. The 51 subjects in the treatment group consisted of 29 females and 22 males, averaging 38.3 ± 12.4 years of age, mean height of 171.2 ± 9.8 cm, and mean weight of 80.4 ± 16.8 kg. The 26 subjects in the control group were composed of 8 females and 18 males, averaging 39.5 ± 10.2 years of age, mean height of 173.7 ± 7.8 cm, and mean weight of 85.8 ± 15.8 kg.

In the treatment group, the mirror-image exercises, mirror-image mechanically assisted postural manipulations, and lateral translation traction trial duration were three to five times weekly for 12 weeks. Traction time started at approximately 3 min and increased 1 min per session until the goal of 10 to 20 min per session was reached. The new type of lateral cervical translation traction has been termed “Berry translation traction” (originated by Dr. Bob Berry, New York) because of the lateral force providing a transverse load on the head and neck while the rib cage is fixed. For lateral head translation posture, **Figure 2** illustrates Berry lateral translation traction, and **Figure 3** depicts the mirror-image exercise. **Figure 4** presents the mirror-image, mechanically assisted postural manipulation.

AP cervicothoracic radiographs were obtained while subjects were standing with their shoulders centered against the cabinet with a standard tube distance of 101.6 cm (40 in.). A 7×17 in. cassette was used with central ray at the episternal notch for visualization of the upper thoracic spine. Before exposure, subjects were asked to close their eyes, nod their heads twice, and assume a comfortable resting position. This neutral resting posture has been shown to be highly repeatable [13].



Figure 2.

This figure demonstrates the “Berry lateral translation traction” used in this study. The patient is placed in the supine position and three snug, but not uncomfortable, straps secure her rib cage. The head is held in place by two padded restraints. The table allows translation opposite the patient’s abnormal posture. The time begins with 3 min and progresses to 20 min over a period of several visits, never exceeding patient tolerance.

The AP cervicothoracic radiographs were analyzed with a modified Risser-Ferguson method, which includes a lateral translation distance of C2 compared to T3, a Risser-Ferguson angle at mid-neck, and an angle of lateral bending of T1–T3 compared to vertical. The Risser-Ferguson method creates an AP radiographic angle by connection of the centroids of the top, apex, and bottom vertebral bodies with the intersection of the vertebral body diagonals. Because the cervical vertebral bodies do not appear nearly as rectangular in shape as the lumbar and thoracic vertebrae on AP radiographs, the mid-lateral margins were used for determination of the cervical



Figure 3.

In the mirror-image exercise, in addition to the opposite translation traction, the patient is instructed to exercise the muscles of the cervical spine and upper trunk either in full range of opposite motion or with resistance of a bungee cord. The patient is instructed to begin with 10 repetitions held for no more than 10 s. As she progresses with 10 s contractions, the repetitions are increased to 50 to 100 per session if no increase in pain. The attending physician should carefully supervise to assure that this is pure side shift and that no abnormal rotation around any axis is present.

centroids, and thus we termed this the “modified Risser-Ferguson method.” This AP radiographic method has been reported to have inter- and intraclass correlation coefficients in the high ranges, with low observer standard errors of measurement (SEMs) $SEM \approx 1^\circ$ angles and $SEM \approx 1$ mm for distances) [14].

To compare data between and within groups, we conducted two-sided, two-sample *t*-tests; Mann-Whitney two-sample tests; and two-sided paired *t*-tests with the software Minitab (version 12, Minitab, Inc., State College, PA, 1998).

RESULTS

Recently, several authors have suggested that treatment groups and control groups be compared for matching characteristics. Our treatment subjects and control subjects were closely matched for mean age, height, and initial pain scores, while differing slightly in mean weight by approximately 5 kg, which was not statistically significant (**Table 1**). The weight difference may have been due to the gender composition of each group (treatment group 57% female, control group 31% female). While the initial pain scores (NRS) were not statistically different (4.0 and 3.5), the follow-up pain scores were statistically significantly different for the treatment group subjects (0.7) and control group subjects (3.6).

For the control group, pretreatment and posttreatment AP radiographic angles changed less than 1° for the difference of the means after 50.4 weeks of no treatment (**Table 2**). Using paired *t*-tests for equality of the means derived from radiographic analysis, we found no statistically significant differences in two angles. Also for the control group, we found no statistically significant change in the lateral head translation measured as C2 relative to T3 from pre- to postradiograph (**Table 2**).

For the treatment group, the treatment duration was 12.8 ± 3.3 weeks between initial and follow-up evaluation. All treatment group radiographic measurements showed statistically significant improvement ($p < 0.0001$) to a more vertical spine. There was an approximately 50 percent decrease (pretreatment score: 13.7 mm, posttreatment score: 6.8 mm) in the lateral translation of C2 compared to a vertical line from T3 (**Table 3**). We separated our subjects for NRS pain and AP cervical measurement improvements above and below the mean and found a clinically but not statistically significant difference: subjects with greater NRS pain improvements had an angle change of 2.0° , and subjects with less pain improvements averaged 1.6° .

Figure 5 presents an example of comparison radiographs of a female subject in the treatment group and illustrates the radiographic measurements.

DISCUSSION

Fifty-one treatment subjects with lateral head translation posture and chronic neck pain, receiving opposite lateral head translation exercises, traction, and mechanically



Figure 4.

Mechanically assisted postural manipulation is performed with a device known as a drop table. The patient is positioned in side posture with her median-sagittal plane of the head translated (lower) compared to the median-sagittal plane of the rib cage. A light thrust will cause the drop head piece to lower approximately 1 in., thereby mirror-imaging the patient's original right-side-shifted posture into left-shifted posture.

assisted postural manipulation, were compared to twenty-six control subjects with chronic neck pain and lateral head translation posture. We had hypothesized that these mirror-image postural methods would reduce this abnormal head posture and thereby reduce the x-ray displacement. The radiographic measurements indicate that this hypothesis is supported. We suggest that improved head posture is due to the unilateral tension created by the protocols on the spinal and paraspinal structures.

This study determined if the mirror-image postural methods created by Harrison [12] could result in improved postural position. In future randomized studies, treatment procedures could be separated into different groups

receiving only mirror-image exercises, only mirror-image traction, or only mirror-image mechanically assisted manipulation, and combinations of these methods. Additional limitations exist in any control trial that is not randomized. For example, we cannot draw complete conclusions regarding the improvement in NRS because of previous studies that have indicated that spinal manipulation can reduce pain [4]. Some may speculate that the observed corrections in AP cervical posture and x-ray measurements are transient; a longer follow-up time period could be performed in a randomized clinical trial to address this issue.

Table 1.

Comparison of subject characteristics for control group versus treatment group.

Variable	Control Group, <i>N</i> = 26 (Mean ± SD)	Treatment Group, <i>N</i> = 51 (Mean ± SD)	<i>p</i> (Between Groups)
Age (yr)*	39.5 ± 10.2	38.3 ± 12.4	0.44 ⇒ >0.05
Height (cm)†	173.7 ± 7.8	171.2 ± 9.8	0.23 ⇒ >0.05
Weight (kg)†	85.8 ± 15.8	80.4 ± 16.8	0.27 ⇒ >0.05
NRS, Pretrial†	3.5 ± 2.0	4.0 ± 2.1	0.29 ⇒ >0.05
NRS, Posttrial†	3.6 ± 1.8	0.7 ± 0.8	<0.0001
<i>p</i> (NRS Within Groups)‡	0.84 ⇒ >0.05	<0.0001	—

*Mann-Whitney two-sample test
†Two-sided, two-sample *t*-test
SD = standard deviation
NRS = numerical rating scale (0 = no symptoms, no limitations to daily living; 1, 2, . . . ,10 = severe pain and bedridden)
‡Two-sided paired *t*-tests for NRS scores within groups

Table 2.Anteroposterior cervical control group (*N* = 26) average x-ray measurement comparisons. Average follow-up X ray was 50.4 weeks.

Variable	Pretrial X ray (Mean ± SD)*	Posttrial X ray (Mean ± SD)	Change	<i>p</i> *
TxC2-T3 (mm)†	8.1 ± 5.7	8.8 ± 5.2	-0.7 mm	>0.05
CD Angle (°)	4.9 ± 3.4	5.0 ± 3.9	0.1°	>0.05
Rz Angle (°)	3.4 ± 3.2	3.8 ± 3.6	0.4°	>0.05

*Two-sided paired *t*-test
†Lateral distance of C2 from a vertical line through T3
SD = standard deviation
CD = cervicodorsal angle is the Risser-Ferguson angle formed at mid-neck by best-fit lines through centroids
Tx = horizontal distance of C2 body to vertical line through the mid-body of T3 or apex vertebral body to vertical line through the mid-body of T3
Rz = lateral bending of line through centroids of T1-T3 from vertical

Table 3.Treatment group (*N* = 51) average anteroposterior cervical x-ray measurement comparisons. Follow-up radiographs after mean of 36.9 visits and taken at mean and standard deviation (SD) of 12.8 ± 3.3 weeks.

Variable	Pretrial X ray (Mean ± SD)	Posttrial X ray (Mean ± SD)	Change	<i>p</i> *
Tx C2-T3 (mm)	13.7 ± 5.0	6.8 ± 5.0	6.9 mm	<0.0001
CD Angle at Mid-Neck	5.7° ± 2.6°	3.9° ± 2.5°	1.8°	<0.0001
Rz Angle at T3	3.8° ± 2.7°	2.6° ± 2.2°	1.2°	<0.0001
Tx of Mid-Neck (Apex Vertebra) (mm)	8.9 ± 6.0	4.5 ± 4.9	4.4 mm	<0.0001

*Two-sided paired *t*-test
Tx = horizontal distance of C2 body to vertical line through the mid-body of T3 or apex vertebral body to vertical line through the mid-body of T3
Rz = lateral bending of line through centroids of T1-T3 from vertical

Additionally, the validation of the Risser-Ferguson method to neck pain intensity and/or disability has not been proven by this study. We separated our subjects for pain and measurement improvements above and below the mean and found a clinically but not statistically significant difference. Whereas subjects with greater NRS pain improvements had an angle change of 2.0°, subjects with less pain improvements averaged 1.6°. In a sample of 50 neck pain whiplash-injured subjects compared to 35 age-matched controls, Zatzkin and Kveton [15] found AP cervical x-ray scoliosis to be five times more likely in

the pain subjects. Although this provides clinical evidence for the validity of AP cervical displacement measurements, clearly there is a paucity of information on this topic. Further study into the validity of AP cervical displacements is a current project of ours. We are collecting cross-sectional information on chronic neck pain subjects, looking for incidence and magnitude of displacements, and will see if there is a correlation with NRS, the Neck Disability Index (NDI) questionnaire, and the Short Form 36-question questionnaire (SF-36).

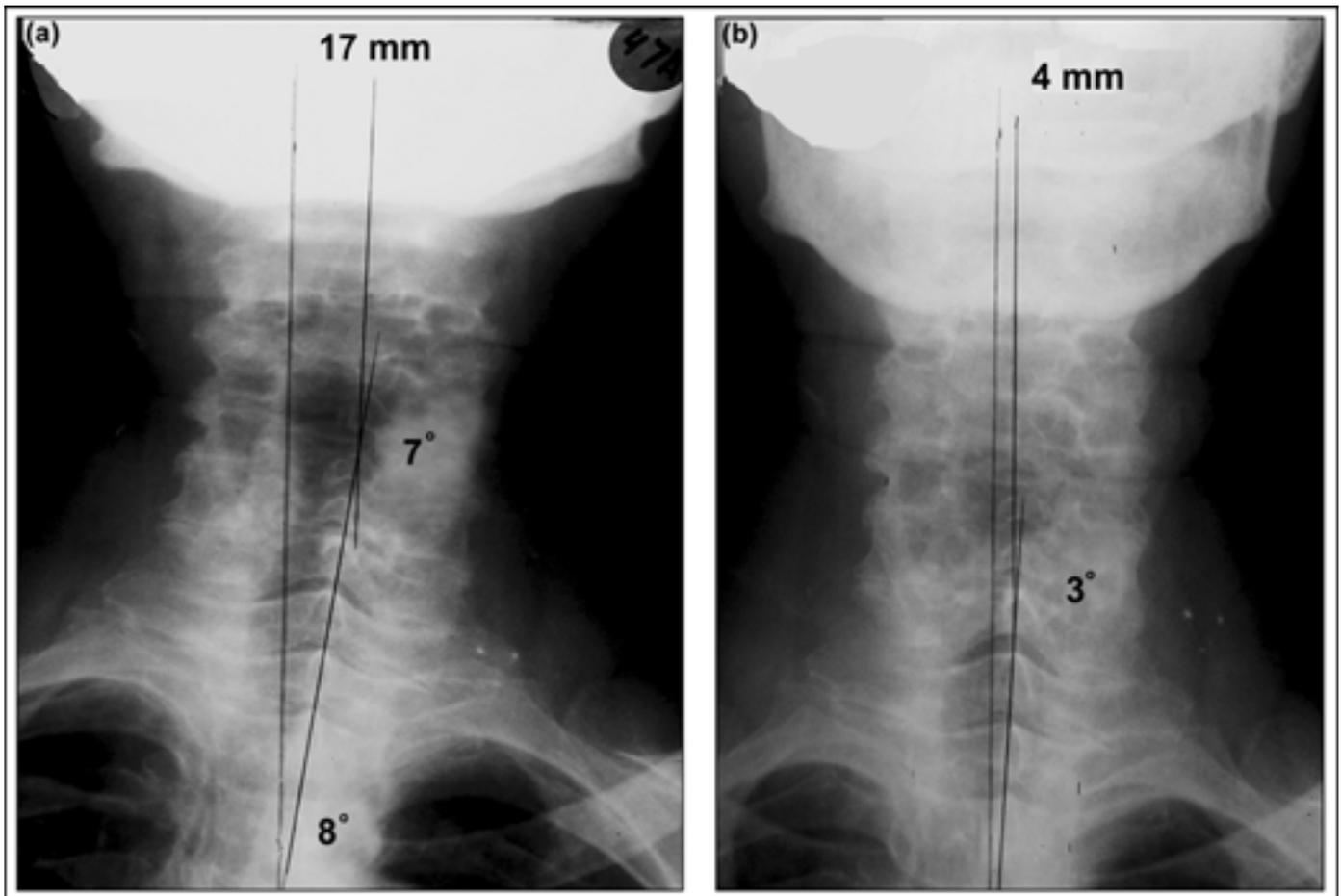


Figure 5.

An 80-year-old female in the treatment group with side-shift posture and chronic neck and arm pain. (a) The pretreatment anteroposterior cervical alignment shows a 17 mm displacement of the neck. (b) After 35 visits in 13 weeks, the posttreatment radiograph shows a reduction in head translation to 4 mm (13 mm change).

Many clinicians and researchers may not be as familiar with the Risser-Ferguson method compared to the Cobb method of AP spinal x-ray displacement measurement. These methods both measure AP cervical lateral bending angulation. The Risser-Ferguson method has been compared to Cobb angle measurements by several investigators. For example, Stokes et al. [16] suggested using the Risser-Ferguson method in situations where the Cobb angle measurement is technically difficult or invalid. They have suggested a ratio of 1.35 to 1 for Cobb angles to Risser-Ferguson angles on AP radiographs.

Previous controlled clinical trials were not found in the biomedical literature for the abnormal posture of lateral translation (side shift) of the head treated with conservative care. However, two studies have been undertaken to analyze the Harrison mirror-image meth-

ods on abnormalities in the sagittal plane [9,17]. These studies, the first of their kind, found that statistically and clinically significant changes in spinal alignment can be made following protocols of extension traction and mechanically assisted postural manipulations.

Other studies that use conservative care aimed at correction of abnormal postural permutations are rare. While some may state that the changes found in previous studies and this study are the result of manipulation alone, the literature does not support this suggestion. Manipulation has been shown to be effective for pain relief and increased range of motion, but it has not been implicated in causing changes in the static position of the spine [4,18].

Traditional cervical traction has the goal of creating a decrease in cervical lordosis with forces applied in the flexion position. The effects are separation of vertebrae,

increase in the width of the foramina, and stretching of the posterior cervical musculature. The effects have been documented radiographically [19–22]. This suggests that, in the current investigation, the changes visualized on the radiographs would be due to the application of the traction forces to the lateral cervical structures.

The ligamentous structures of the spine are viscoelastic. The deformation of these structures is, mechanically, time-dependent and force-dependent [23]. When under loading, spinal ligaments complete a stress-relaxation process in approximately 500 s (8.33 min). However, the intervertebral disk will continue to deform for 20 min to 60 min [24]. For this reason, we progressed the traction up to 20 min to attain the maximum amount of deformation to the paraspinal structures in a clinically efficient time period.

Some recent literature has indicated that spinal manipulative therapy is an effective treatment for some cervical spine pain syndromes [25,26]. In a 1997 review, Shekelle and Coulter [25] evaluated nine controlled trials of cervical manipulation for neck pain (five trials for subacute or chronic neck pain) and headaches (three trials for tension headaches and one trial for migraines). They then gave these trials to a multidisciplinary panel, who rated the use of cervical spine manipulation for appropriateness. Jordan et al. [26] separated 119 chronic neck pain subjects into three groups: (1) intensive neck and shoulder musculature exercise, (2) individual physiotherapy treatment, and (3) spinal manipulation (with some manual traction). At 6 weeks, 4 months, and 12 months follow-up, all three groups had significant pain improvements and results were similar for all groups [26]. These studies seemed to suggest that exercise, physical therapy, and cervical manipulation (with some adjuncts) have similar outcomes in some cervicogenic pain syndromes.

The application in the present study of these new “mirror-image” methods of traction, exercise, and mechanically assisted manipulation indicates the need for future studies of each treatment modality in a randomized clinical control trial format. Furthermore, the resulting decrease in NRS score may be associated with the isometric, sustained contraction during the mirror-image postural exercise. Recent studies have shown that isometric exercise can lower resting blood pressure, modulate autonomic control, and improve overall health [27–29]. This improvement may contribute to enhanced quality of life and would further explain the decrease in NRS for the treatment group. Future randomized studies can discrimi-

nate between patients who perform only one of the mirror-image protocols and those who do not, and the subsequent result in outcome measures.

CONCLUSION

Fifty-one chronic cervical pain subjects with lateral head translation posture had statistically and clinically significant changes in pain scales and AP radiographic measurements. A new type of lateral translation traction, combined with postural mirror-image exercises and mechanically assisted manipulation, produced significant radiological changes and positive changes in NRS pain outcome measures. Following treatment, an approximate 50 percent improvement was noted in abnormal lateral head translation posture. For the control group, neither clinically nor statistically significant changes were observed at follow-up. Future projects need to address the validity of the cervical spine displacement measurements used in this study.

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