Case Report

Reduction in Cervical Anterolisthesis & Pain in a 52-Year-Old Female Using Chiropractic BioPhysics® Technique: A Case Study and Selective Review of Literature

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Abstract

Objective: The purpose of this study is to report on the structural and symptomatic improvements made in a patient with a cervical spondylolisthesis using Chiropractic BioPhysics® technique.

Clinical Features: A 52-year-old female presented for chiropractic care with frequent and severe neck pain, neck stiffness, and pain in the upper back. A neutral lateral cervical x-ray displayed anterolisthesis at C4-C5 measuring 2.4mm (ideal is 0mm). Also present was an anterior head translation measuring 19.66mm (ideal is 0mm) and an absolute rotational angle from C2-C7 measuring -22.8° (ideal is -42°).

Intervention and Outcomes: The patient received chiropractic care 30 times over 3 months using Chiropractic BioPhysics® technique protocols. Follow-up examination revealed that the patient achieved a correction of her C4-C5 spondylolisthesis from 2.4mm to 0.7mm. Her anterior head translation was reduced from 19.6mm to 9.0mm, and the absolute rotational angle from C2-C7 improved from -22.8° to -26°. The patient also reported a resolution of her pain, stiffness, tension, and swelling symptoms.

Conclusion: This case study demonstrates the successful reduction of cervical spondylolisthesis and improvement of sagittal spinal alignment and cervical lordosis in a 52-year-old female with cervicothoracic pain and postural abnormalities using Chiropractic BioPhysics® technique. Further research is suggested for either a case series or clinical trial to see how conservative chiropractic care can negate the need for surgical intervention of cervical spondylolisthesis.

Key Words: *chiropractic, subluxation, spondylolisthesis, cervical spine, degenerative cervical spondylolisthesis, DCS, Chiropractic BioPhysics®, CBP®, Mirror Image®, adjustment, traction, posture, translation, spinal instability*

Introduction

Degenerative cervical spondylolisthesis (DCS) had previously been thought to be a rare condition when compared to degenerative lumbar spondylolisthesis.[1] However, with consequences from untreated spondylolisthesis including pain, myelopathy, and radiculopathy, it has now become recognized as an under-studied condition which may be more prevalent than previously thought.[1,2]

Spondylolisthesis of the spine refers to an anterior or posterior displacement of vertebrae relative to the vertebrae below.[3] In the cervical spine, anterior or posterior vertebral displacement typically results from degenerative or traumatic causes.[1] Trauma is the most common cause of spondylolisthesis in the cervical spine.[1] Injuries that most often lead to traumatic cervical spondylolisthesis include fracture of the C2 vertebrae (hangman fracture), uni- or bilateral facet dislocation, and facet fracture subluxation.[1]

DCS occurs secondary to a degenerative cascade starting with joint narrowing, marginal osteophytes, and bone fragmentation eventually leading to capsular laxity.[4] DCS transpires mainly in patients older than 50 years old.[5] DCS can be attributed to disc degeneration and hypertrophic facet arthrosis associated with spinal senescence.[1] Arthritic and ankylosing conditions leading to spinal rigidity further exacerbate these conditions. Decreased mobility increases stress levels on intervertebral discs and the facets of adjacent vertebrae. This increased stress leads to ligament laxity and disc displacement allowing translation of the vertebrae.[1]

While literature has established DCS as a rare and under-documented condition, recent efforts have begun to highlight its occurrence.[1,2] A retrospective study by Suzuki et al. cited C3-C4 and C4-C5 disc levels as the most commonly found locations of DCS.[6] These findings were supported by a systematic review of DCS patients, which found that C3-C4 was present in 46% (81/176), and C4-C5 was present in 49.4% (87/176).[1] The same review found that 51% (52/102) of patients with DCS presented with neck or occipital pain; 22.5% (23/102) presented with radiculopathy; and 63.7% (65/102) presented with myelopathy/radiculo-myelopathy.[1] Two symptomatic presentations were seen in those with DCS-related instability. Patients of this type either presented with neck pain or neurologic findings including cervicobrachial pain or myelopathy.[7]

Woiciechowsky, et al. categorized DCS into three stages based on symptomatic presentation, morphological appearance radiographically, and the suggested surgical procedure for each type. Stage 1 presented with pain and with noticeable facet joint degeneration on radiographic examination. Stage 2 patients presented with radiculopathy or myelopathy and degeneration of the facet joints and vertebral bodies. Stage 3 patients presented with severe myelopathy and spinal deformity.[2] Based on these presentations, specific surgical interventions were recommended. Stage 1 required single vertebral level discectomy, repositioning, and fusion. Stage 2 was multi-level discectomy, repositioning, and fusion. Stage 3 necessitated excision of the vertebral body and subsequent replacement along with fusion of adjacent segments.[2]

In a retrospective analysis of kinetic magnetic resonance images (MRI) of 468 symptomatic patients, Suzuki, et al. found a 16.4% prevalence of grade 1 CDS and 3.4% prevalence of grade 2 CDS. Here, grade 1 spondylolisthesis was defined as vertebral displacement of 2-3mm and grade 2 as vertebral displacement of >3mm.[6]

Often the first symptom of a spondylolisthesis is neck pain. Patients may also present with signs of varying levels of neurological compromise.[2] The possible consequences of untreated DCS include worsening pain, myelopathy, radiculopathy, and in rare cases, vertebral artery stenosis.[7,8]

As of 2011, there are no medical guidelines for the treatment of DCS.[1] Less severe spondylolisthesis of a 1-2mm slip may cause few or no symptoms, and is not considered in need of surgical attention. However, surgical treatment is indicated in patients who have radiologically proven instability or spinal cord compression.[1] For such surgical cases, the most common treatment methods include ventral, dorsal, and combined fusion techniques with or without repositioning and decompression.[2]

Review of Literature

Medical Management

Dean, et al. analyzed the cases of 58 patients with CDS treated surgically. Thirty-five of these patients underwent corpectomy, and 23 patients were treated with discectomy and anterior fusion. Patients underwent an evaluation at an average of 6.9 years, and the majority displayed a drastic decrease in symptoms. 83.3% of patients who presented with radiculopathy saw a complete cessation of their symptoms. 44.7% percent of patients saw complete resolution of their pain while 50% reported improvements in their pain levels.[9] Similarly, Deburge et al. reported the cases of 8 patients with unstable CDS who were treated using either anterior or posterior fusion. Subjects were divided into two groups based on presenting symptoms. The first group presented with neck pain only. The second group presented with brachial plexus pain or myelopathy. The post-surgical evaluation was conducted on all patients over the next seven years and all reported symptomatic resolution.[7]

Woiciechowsky, et al. presented a study of 16 patients with DCS treated through a combination of discectomy, fusion, corpectomy and decompression. In this study, eight patients presented with myelopathy, five with radiculo-myelopathy, and three with neck pain only. Pain was reported as an initial symptom in all 18 patients. Upon follow-up, all patients reported pain relief and 10 of 13 showed signs of neurologic improvement.[2]

Zwingenberger, et al. published on surgical management of a 63-year-old patient with a 13mm anterior spondylolisthesis at C7-T1. The patient presented with paresthesia, muscle weakness, and decreased function of the hands bilaterally. MRI revealed compression of the cervical spinal cord extending from C5-T1. The surgical intervention involved discectomy, laminectomy, fusion, and stabilization above and below the C7-T1 segments. Post-surgical evaluation showed resolution of paresthesia and hand pain although there was marginal decrease.[10]

Ido, et al. reported the case of a 56-year-old male with traumatic C6-C7 spondylolisthesis induced during a traffic accident. Radiographs indicated fractures of the right pedicle and the left lamina. Initially, the patient was treated with neck flexion and longitudinal distraction, but this course of care was discontinued following an increase of radicular symptoms into the right upper extremity. The patient was placed in a halo brace in slight flexion for two days to reduce the spondylolisthesis before performing stabilization surgery. X-rays were taken and the C6 anterior displacement was considerably reduced. Following this reduction, surgery was performed and the vertebra was stabilized. The patient, however, did complain of slight numbness in his right index finger.[11]

Chiropractic Management

Reports of the successful chiropractic treatment of DCS are less abundant than in surgical treatment. The chiropractic cases report on reduction of symptoms instead of correction of spinal alignment. Rowe and Steiman reported on the case of two patients (a 28-year-old female and a 29-year-old male) both presenting with anterolisthesis of C6 with a 3mm displacement. In both cases, spina bifida was present at the spondylolisthesis segment. Upon orthopedic examination, both patients presented with hypomobility at the C5-C6 segments with all other physical and neurological exams unremarkable. Treatment involved spinal manipulation of the hypomobile segments. The female patient reported remission of her headaches after only two adjustments, and the male patient reported alleviation of his neck pain.[12]

Bennett and Hayde published a case of a 36-year-old male with anterolisthesis at C6-C7. The patient's symptoms included headaches, neck pain, and stiffness. Spinal manipulation aimed at mobilizing the cervical segments and myofascial trigger point therapy was administered over the course of two weeks and the patient's symptoms subsided. It was not reported whether or not the practitioner reduced the spondylolisthesis and follow-up radiographs were not performed.[13]

Cox published a case of chiropractic treatment administered to a 65-year-old female presenting with spondylolisthesis at C7 along with pain in the low back, legs, shoulders, and weakness in both legs. Treatment of the patient involved distraction manipulation by contacting the C6 vertebra (vertebrae directly above the location of spondylolisthesis), along with spinal manipulation, ultrasound, and electric current therapy.[14] Initially, all subjective complaints displayed improvement, but within a month of treatment, her motor skills declined. Shortly after that, the patient suffered a cerebrovascular accident, necessitating wheelchair use and bed confinement.[14] Despite the aftereffects that occurred in this particular case, the authors believe that traction is still a safe avenue of treatment and that neurological injury would be a rare result.[14]

Due to the shortage of published chiropractic cases focused on structural improvement to CDS, it is important to highlight studies where measurable changes made to the cervical curvature in chiropractic patients resulted in physiologic improvements. The importance of focusing on structural improvement of the spine is illustrated in this case study and how that improvement may help reduce spondylolisthesis and resolve associated patient complaints.

Fedorchuk and Wheeler presented the case of a 13-year-old patient with a 4-year history of cervicogenic headaches, upper cervical subluxations, and a decreased cervical curve.[15] As per CBP protocol, cervical radiographs were taken before chiropractic care. Findings included anterior head translation (-TxH) of 29.6mm and a cervical lordosis absolute rotational angle (ARA) of -3.8°, as opposed to the ideal angle of -42°.[15] Chiropractic treatment included spinal manipulative therapy and Mirror Image® adjustments, 2-way traction, and exercises. Post-treatment radiographs showed a reduction of anterior head translation to 17.6mm, and an ARA measuring -43.4°, and correlated with the elimination of the patient's headaches.[15]

Similarly, Cardwell and Barone reported a case of improvement of both the cervical and lumbar curves in a 34-year-old male patient using CBP treatment.[16] The patient presented with a 20-year history of headaches, mid- and low-back pain, congested sinuses, and upper respiratory conditions. Upon evaluation of the patient's posture, several abnormalities were found including right lateral head translation (-TXH), anterior head translation (+TzH), decreased lumbar lordosis, and pelvic distortion. Following a 9-month period of CBP® care, spinal alignment improved towards normal for all postural distortions and subluxations. The patient also experienced an associated improvement in headaches, sinus congestion, and upper respiratory conditions.[16]

Chiropractic care has been shown to improve a hypolordotic cervical curve as well as a hyperlordotic cervical curve. Morningstar reported a case of a 27-year-old male patient with sharp, stabbing mid-back pain.[17] Upon physical and radiographic examination, the patient was found to have a cervical curve of 52° as opposed to the normal range of 34° to 42°. The patient also presented with forward head translation of 15mm. The patient's care plan included spinal manipulative therapy combined with a 4lb head weight device, wearing a figure-8 clavicle brace, and positional and intersegmental traction. Over the course of 10 visits, the cervical curve was reduced to 40° (normal range) and all symptoms were alleviated.[17]

Case Report

Patient History

A 52-year-old female presented with neck pain, neck stiffness, and thoracic pain. The patient indicated that she experienced the pain frequently and that the pain was severe and produced a tense and swelling sensation to her lower cervical and upper thoracic areas. The patient denied a history of trauma to the area.

Radiographic Evaluation

An initial neutral lateral cervical (NLC) x-ray (Figure 1A) displayed a significant anterolisthesis at C4-C5 measuring 2.4mm. Anterior translations were also seen at C6-C7 (0.6mm) and C7-T1 (1.4mm). Posterior translations were seen at C2-C3 (2.0mm), C3-C4 (1.3mm), and C5-C6 (2.2mm). Also present was an anterior head translation (+TzH) measuring 19.66mm and a -22.8° ARA from C2-C7. Ideal head translation relative to the thorax should be 0mm and ideal ARA from C2-C7 should be -42°.[15] Radiographic measurements (Figure 1B) and lines were created using the PostureRay® Electronic Medical Records (EMR) software (PostureRay® X-Ray Electronic Medical Records Software, PostureCo, Inc., Trinity, FL, USA), which utilizes the Harrison Posterior Tangent Method and the Harrison Spinal Model for analyzing sagittal spinal views.

Intervention and Outcomes

The patient was examined for subluxations and spinal and postural misalignments as per CBP® protocols. CBP® technique focuses on normalizing spinal-pelvic weight bearing through structural rehabilitation with the intent of optimizing spinal alignment and posture.[18] The patient received CBP® treatment during 30 visits over the course of three months. Mirror Image® adjustments were applied to the cervical spine in which the patient was adjusted in the opposite postural position as the postural distortions with which she presented. These adjustments included the use of an OMNI elevation chiropractic drop table and an Impulse® adjusting instrument (Impulse® Adjusting Instrument, Neuromechanical Innovations, Chandler, AZ, USA) on the lowest setting. The purpose of using Mirror Image® position for cervical adjusting is to reset the nervous system's regulation of postural muscle balance.[19] By reducing the increased rotational loads brought about by deviant posture, the adjustment reduces stresses on neuromuscular structures.[18] Mirror Image® traction was performed using a white Denneroll spinal orthotic (Cervical Denneroll Spinal Orthotic, Denneroll Spinal Orthotics, New South Wales, Australia) placed just below C5 for periods starting at 3 minutes and increasing 2 minutes of traction with each visit until 20 minutes was reached. The purpose of this method of traction is to trigger viscoelastic deformation in the resting length of the spinal muscles, ligaments, and discs.[19] Mirror Image® exercises consisted of a 2-step movement pattern. First, the patient performed maximum anterior head translation (+TzH). Second, the patient performed maximum posterior head translation (-TzH) while simultaneously adding head extension (-RxH) and holding the final position for 5-10 seconds before relaxing and repeating. To achieve and maintain spinal correction in patients with spinal and postural abnormalities, it is necessary to strengthen weak musculature and lengthen tight musculature that have adapted to unhealthy posture with Mirror Image® exercises.[19]

At the end of the 30 visits, a post-treatment NLC x-ray was taken and compared with pre-treatment assessments. The most significant translational change occurred at C4-C5 with a reduction of 1.7mm from 2.4mm to 0.7mm (70.8% change). Anterior translation at C6-C7 was reduced 0.9mm and C7-T1 was reduced 1.3mm. Posterior translation at C2-C3 was reduced 1.1mm, C3-C4 reduced 0.5mm, and C5-C6 reduced 1.5mm. The anterior head translation was reduced 10.0mm from 19.6mm to 9.0mm. The ARA from C2-C7 improved from -22.8° to -26° (Figure 1C). The patient also reported a resolution in her pain, stiffness, tension, and swelling.

Discussion

Abnormal posture, translational instability of vertebral segments, and abnormal facet angles have all been found to be predisposing factors for cervical degeneration and spondylolisthesis. These physiological changes can result in altered biomechanics leading to increased stress on the intervertebral discs and joints of the spine.

Translational instability at levels of CDS has been reported along with decreased segmental spinal canal diameter.[6] In a study performed by Suzuki, et al., translational instability was observed with a prevalence of 16.7% in grade 2 spondylolisthesis, 4.3% in grade 1 spondylolisthesis, and 3.4% in segments with no spondylolisthesis. This data suggests that translational instability of the cervical spine can be a precursor to CDS.[6]

Woiciechowsky, et al. propose an idea based on the assumption that degeneration of the disc and facet joints leading to spondylolisthesis first occurs in association with instability of the neck.[2] With neck pain being the most common symptom for patients with cervical spine instability, degeneration of discs and vertebral bodies may be mild at this stage of presentation. However, if instability proceeds faster than restoration, spondylolisthesis may most likely follow.[2] With this correlation between neck pain, instability, and a predisposition to spondylolisthesis, increased clinical awareness surrounding patient presentations of neck pain is warranted.

Vertebral facet angles have also been identified as a predisposing factor for DCS.[20-22] The orientation of the facet joints along the sagittal plane is referred to as the pedicle-facet (P-F) angle.[20] The slope of the T1 vertebrae can predict the balance of the cervical spine along the sagittal plane. Jun, et al. found a greater degree of T1 slope in patients with DCS.[21] Based on these findings, Kim, et al. hypothesized that a high T1 slope, which is indicative of loss of sagittal alignment in the cervical spine, increases the magnitude of shear force along the gravitational vectors of the facets increasing possibility of spondylolisthesis.[20] This constant anterior shear force can lead to arthritic changes in the posterior facets, accelerating disc degeneration and collapse.[20]

The study by Kim, et al. examined P-F angles of participants with DCS.[20] Larger facet angles were found at the C4-C5 level in the DCS group when compared to the control group.[20] Xu, et al. analyzed the relationship between facet tropism, defined as asymmetry between the left and right vertebral facet joint angles and DCS.[22] Their findings indicated that facet tropism severity at the C3-C4 and C4-C5 levels in the experimental group were far more pronounced than at the same levels in the control group. This suggests a relationship between facet tropism and DCS.[22] A high incidence of DCS at the levels of C4-C5 is related to hypermobility of these segments, with repeated movements leading to laxity in the surrounding ligaments and degenerative articular changes.[20]

Postural abnormalities, such as loss of cervical lordosis, are well documented as risk factors that can result in degeneration of the cervical spine. Loss of cervical lordosis has been indicated as a precursor for myofascial pain, neurovascular entrapment, and ultimately degeneration of the cervical spine.[16] A study by McAviney, et al. found that patients with a lesser degree of cervical curve were found to have greater instances of both pain and headaches.[23] Degenerative changes of the cervical spine were also found to occur more rapidly when postural imbalances lead to a transition towards cervical kyphosis (reversed curve).[24]

Proposed Neurophysiological Mechanisms

CBP® technique views postural distortion as a cause rather than a consequence of segmental dysfunction.[25] The structures primarily affected by poor posture include spinal ligaments, intervertebral discs, vertebrae, and associated nervous tissues. CBP® research has substantiated abnormal posture as an underlying cause for somato-autonomic reflexes leading to visceral disease, pain, diminished range of motion, articular dysfunction, myofascial lesions, aberrant proprioception and a host of nerve interference complications.[25]

CBP® technique approaches the skeletal system globally as an intricate network of connected parts. The segmental interpretation of a subluxation is primarily understood as dysfunction within a joint complex.[26] Through the study of the kinesiopathological component of subluxation (described by Dishman and Lantz) and the Dysafferentation model (described by Kent), it is clear that postural distortions can lead to degenerative and neurological problems and how correction of these distortions can resolve such conditions.[27]

The kinesiopathological model of subluxation states that an abnormal initial starting position of a vertebra will result in abnormal motion of that vertebra.[16] The patient in this case study presented with abnormal initial starting positions of several cervical vertebrae as a result of the loss of her cervical curve. This abnormal positioning created abnormal motion, leading to dysafferentation.

Dysafferentation is an imbalance in afferent input such that there is an increase in nociceptive input and a decrease in mechanoreceptive input.[26] Intervertebral motion segments of the spine are rich with nociceptive and mechanoreceptive structures. Consequently, if biomechanical dysfunction is present at one or more of these segments, alteration in normal nociception or mechanoreception will result leading to anomalous afferent input to the central nervous system.[27] Because postural neck muscles are meant to respond to proprioceptive muscular reflexes, alterations in this mechanical function can affect postural muscle tone.[27] Under normal conditions muscle spindles and Golgi tendon organs (GTO), in postural neck muscles, send information to the central nervous system about changes in muscle length and tension.[26] Mechanoreceptive input, as well as feedback from muscle spindles and GTOs, are known to influence brain function, proprioceptive input, and suprasegmental motor control. Therefore, it can be concluded that dysfunction in a joint complex can result in “degeneration, atrophy, and deconditioning of mechanoreceptor rich tissues, such as muscles and joint structures.”[26]

Conclusion

Limitations

This study would have benefited from the use of cervical flexion and extension x-rays to further visualize cervical instability as well as MRI to determine any amount of spinal cord compression before and after treatment. An additional measure to support the long-term correction of the spondylolisthesis would be the conduction of follow-up studies to determine if postural changes as a result of treatment continued to improve, stayed the same, or degenerated back to pretreatment positions. Further research is suggested for either a case series or clinical trial to see how conservative chiropractic care can negate the need for surgical intervention in patients with DCS.

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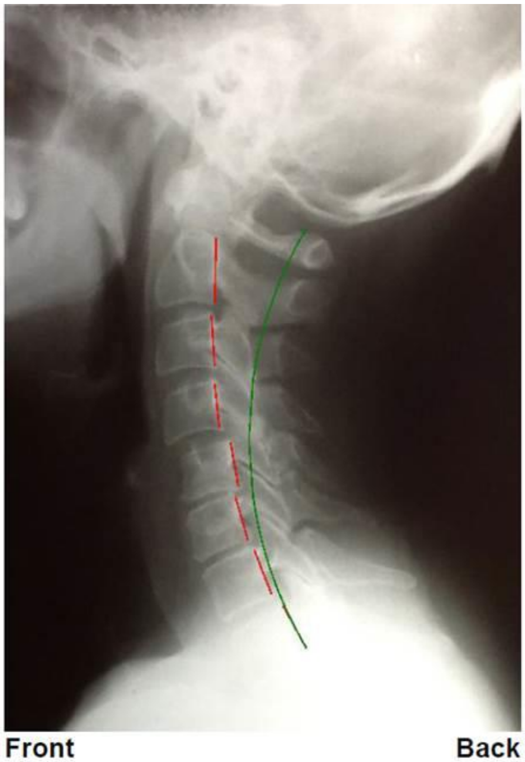

Figure 1A: Pre-Treatment NLC X-ray

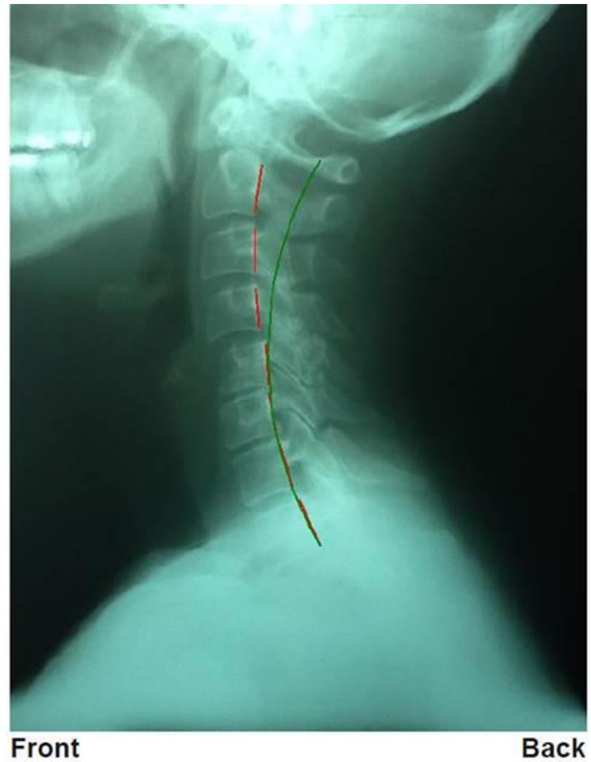

Figure 1B: Post-Treatment NLC X-ray

RRA per Segment	Normal Values	Xray 1 Values	Versus Normal	Xray 2 Values	Versus Normal	% Change: Xray 1 to 2
C1 to Horiz.	-29.0°	-32.8°	13.1%	-31.2°	7.6%	4.9%
C2-C3	-10.0°	-5.0°	50.0%	-8.5°	15.0%	70.0%
C3-C4	-8.0°	-2.5°	68.8%	-5.2°	35.0%	108.0%
C4-C5	-8.0°	-4.0°	50.0%	1.8°	122.5%	145.0%
C5-C6	-8.0°	-5.8°	27.5%	-8.3°	3.8%	43.1%
C6-C7	-8.0°	-5.5°	31.2%	-5.8°	27.5%	5.5%
C7-T1	-8.0°	-7.6°	5.0%	-7.2°	10.0%	5.3%

RRA = Relative Rotational Angle

Translation per Segment	Xray 1 Values *	Xray 2 Values *	% Change: Xray 1 to 2
C2-C3	-2.0 mm	-0.9 mm	55.0%
C3-C4	-1.3 mm	-0.8 mm	38.5%
C4-C5	2.4 mm	0.7 mm	70.8%
C5-C6	-2.2 mm	-0.7 mm	68.2%
C6-C7	0.6 mm	-0.3 mm	150.0%
C7-T1	1.4 mm	-0.1 mm	107.1%

* Values in Red Exceed Established Normal

Global Analysis	Normal Values	Xray 1 Values	Versus Normal	Xray 2 Values	Versus Normal	% Change: Xray 1 to 2
ARA C2-C7	-42.0°	-22.8°	45.7%	-26.0°	38.1%	14.0%
Translation C2-C7	0.0 mm	19.6 mm	19.6 mm	9.0 mm	9.0 mm	54.1%

ARA = Absolute Rotational Angle of Measurement

Figure 1C: PostureRay® Comparison Evaluation of NLC X-rays