

# CONSERVATIVE TREATMENT OF A PATIENT WITH PREVIOUSLY UNRESPONSIVE WHIPLASH-ASSOCIATED DISORDERS USING CLINICAL BIOMECHANICS OF POSTURE REHABILITATION METHODS

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## ABSTRACT

**Objective:** To describe the treatment of a patient with chronic whiplash-associated disorders (WADs) previously unresponsive to multiple physical therapy and chiropractic treatments, which resolved following Clinical Biomechanics of Posture (CBP) rehabilitation methods.

**Clinical Features:** A 40-year-old man involved in a high-speed rear-impact collision developed chronic WADs including cervicothoracic, shoulder, and arm pain and headache. The patient was diagnosed with a confirmed chip fracture of the C5 vertebra and cervical and thoracic disk herniations. He was treated with traditional chiropractic and physical therapy modalities but experienced only temporary symptomatic reduction and was later given a whole body permanent impairment rating of 33% by an orthopedic surgeon.

**Intervention and Outcome:** The patient was treated with CBP mirror-image cervical spine adjustments, exercise, and traction to reduce forward head posture and cervical kyphosis. A presentation of abnormal head protrusion resolved and cervical kyphosis returned to lordosis posttreatment. His initial neck disability index was 46% and 0% at the end of care. Verbal pain rating scales also improved for neck pain (from 5/10 to 0/10).

**Conclusion:** A patient with chronic WADs and abnormal head protrusion, cervical kyphosis, and disk herniation experienced an improvement in symptoms and function after the use of CBP rehabilitation protocols when other traditional chiropractic and physical therapy procedures showed little or no lasting improvement. (*J Manipulative Physiol Ther* 2005;28:205.e1-205.e8)

**Key Indexing Terms:** *Whiplash Injuries; Chiropractic; Kyphosis; Intervertebral Disk Displacement; Rehabilitation; Posture*

**M**any patients seek treatment from various health care providers after trauma sustained in motor vehicle crashes. Traditional approaches for acute and chronic posttraumatic cervical pain typically include a course of spinal manipulation and/or physical therapy aimed toward symptom relief and functional outcomes such as

range of motion (ROM), strength, and proprioception<sup>1</sup> while generally disregarding structurally based objective outcomes such as normal posture and cervical lordosis. When the presenting symptoms decrease and show no continued improvement, a patient is typically weaned from care and considered by most treating physicians to be at a level known as *maximal medical improvement* (MMI) or preinjury status.

Similarly, patients found on imaging studies to have a disk herniation are usually prescribed a course of traditional chiropractic manipulation and/or physical therapy usually including courses of axial distraction traction.<sup>2-4</sup> If this initial conservative care is ineffective at reducing a patient's initial complaints, the health care provider usually suggests seeing an orthopedist or neurosurgeon for a possible surgical intervention.<sup>5</sup>

Although effective for pain management in many cases, this line of standard conservative treatment does not address correction of the hypolordotic, kyphotic, or S-shaped cervical configurations, nor does it address correction of postural abnormalities. Studies have shown that one of the

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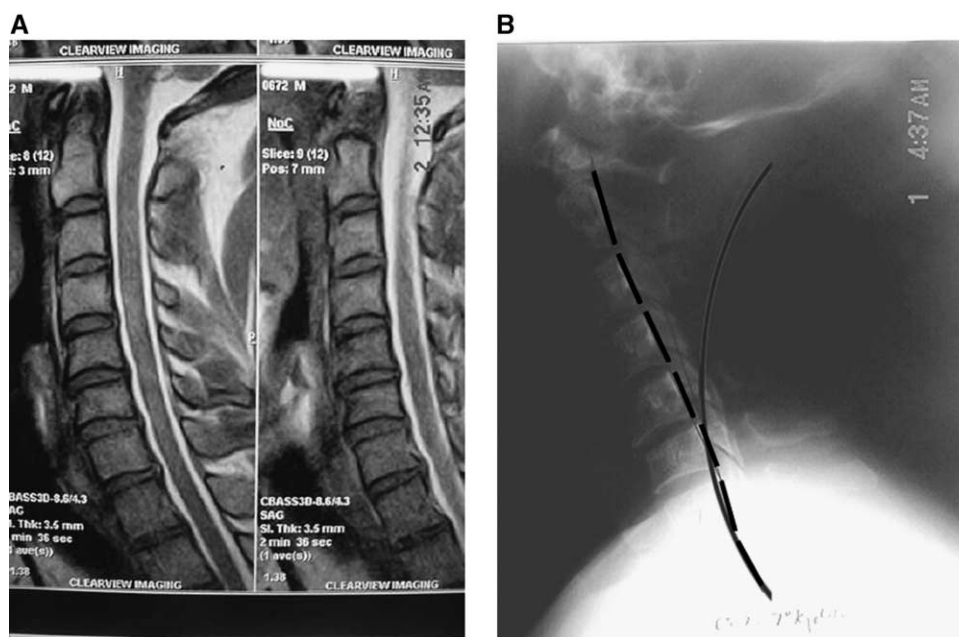
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**Table I.** Initial and follow-up examination cervical ROM using inclinometry for axial rotation ( $\pm R_y^h$ ), lateral flexion ( $\pm R_z^h$ ), flexion ( $+R_x^h$ ), and extension ( $-R_x^h$ )

Main motion	$-R_x^h$	$+R_x^h$	$+R_z^h$	$-R_z^h$	$-R_y^h$	$+R_y^h$
First examination 3/12/2001	36°	54°	30°	20°	30°	28°
Second examination 5/16/2001	51°	54°	40°	30°	60°	45°
Third examination 7/2/2001	65°	68°	55°	58°	90°	80°
Follow-up examination 5/22/2002	47°	57°	33°	42°	78°	89°



**Fig 1.** A, The initial MRI of the lateral cervical spine (10/18/00). Abnormal marrow signal with slight loss of vertebral body height at C5, possibly a very mild compression deformity. Small central disk protrusion at C4-5 and small disk bulge at C5-6. No central canal stenosis or significant neural foraminal narrowing identified. B, The initial lateral cervical view dated 9-15-2000 taken at the previous provider's clinic.

most common findings after a cervical acceleration deceleration is an S-shaped, kyphotic, or hypolordotic cervical curve configuration.<sup>6-14</sup> In addition, an abnormal neutral resting head posture has been found in whiplash-injured subjects compared with control subjects.<sup>15</sup>

In a study of seated lateral cervical radiographs in 488 subjects with acute whiplash injury compared with 495 nonmatched asymptomatic control subjects, Matsumoto et al<sup>16</sup> found no qualitative differences in the sagittal cervical lordosis between the two groups. In contrast, left uncorrected, abnormal cervical curve configurations have been shown to correlate with common symptoms and poor outcomes found in patients with chronic whiplash-associated disorders (WADs).<sup>6-10</sup>

Kessinger and Boneva<sup>17</sup> reported a reduction in an angular cervical kyphosis after multiple toggle recoil adjustments to the upper cervical spine in a subject with an acute whiplash injury. However, to our knowledge, no previous reports using conservative methods have docu-

mented correction of abnormal cervical curve configurations in chronic whiplash-injured subjects.

We present a case of improvement in symptoms associated with chronic WADs with concomitant correction of abnormal sagittal cervical alignment in a patient previously unresponsive to traditional conservative methods who was given a 33% permanent impairment rating.

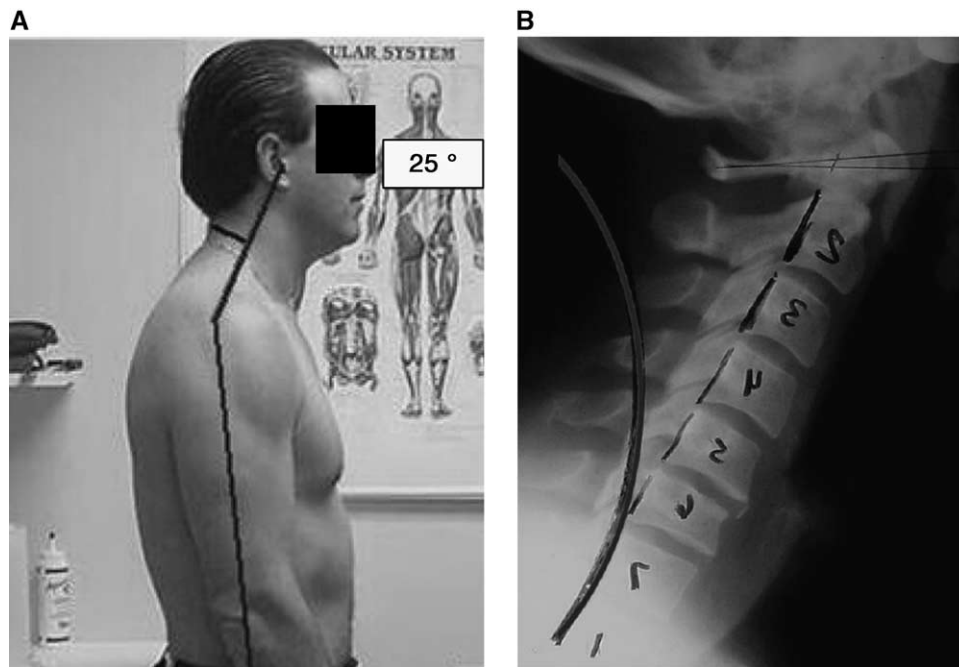
#### CASE REPORT

A 40-year-old man was involved in a high-speed rear-impact crash where his car was the target vehicle. The patient was treated initially by a chiropractor using bilateral cervical spinal manipulative therapy but evidenced no permanent improvement in subjective and objective measures. The patient was then treated for an additional 3 months at a medical rehabilitation clinic with focus on functional rehabilitation. The patient's earlier treatment included func-

**Table 2.** No. of visits and x-ray measurements for analysis of the lateral cervical spine

Date	Visits	APL	C2-7	C2/3	C3/4	C4/5	C5/6	C6/7	+T <sub>z</sub>
9/15/00	1-18	13	+3	-12	0	+5	+10	0	74
3/12/01	1	-4	0	-6	0	0	+8	-2	68
5/16/01	40	16	17	-8	0	-9	+9	-9	32
7/2/01	64	22	22	-2	0	-10	0	-10	20

Atlas plane line to horizontal (APL), cervical lordosis using the Harrison posterior tangent method (C2-C7), segmental angles using the Harrison posterior tangent method (C2-C7), and anterior displacement of the posterior superior lateral mass relative to a vertical line drawn superiorly from the posterior inferior body corner of T1 (+T<sub>z</sub>) are shown. These measurements are reliable.<sup>18</sup>



**Fig 2.** A, The initial neutral lateral cervical posture showing the patient's severe head protrusion. B, The initial lateral cervical obtained at the CBP provider's clinic dated 3/12/2001. Notice the lack of spinal correction after numerous multiple modalities. The broken black line represents the path of the posterior longitudinal ligament (George's line), whereas the solid black line represents normal spinal position described by Harrison et al.<sup>22</sup>

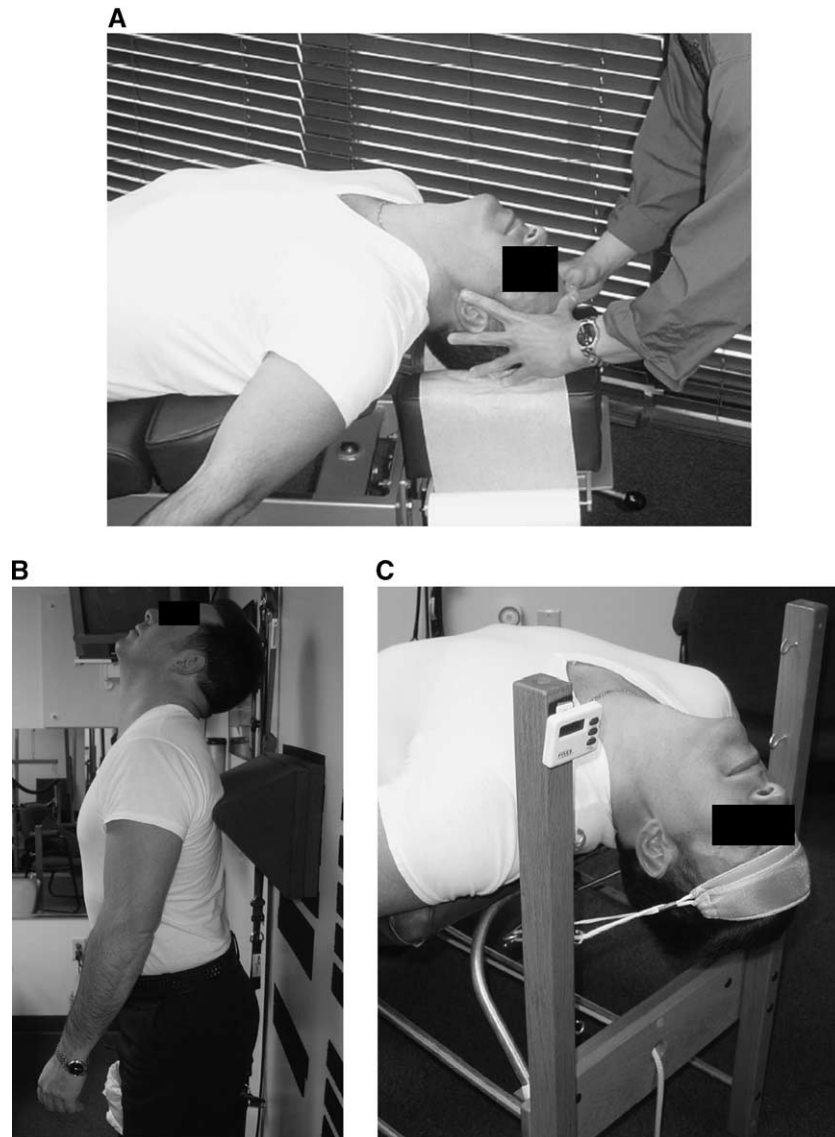
tional rehabilitation (ROM exercises, stretching), electrical muscle stimulation, high-voltage galvanism, ultrasound, deep tissue massage therapy, anti-inflammatory medication, and pain medication. The patient again evidenced no permanent improvement in subjective and objective measures. The patient was given a 33% whole body impairment rating by an orthopedic surgeon and was told that he may need eventual surgical intervention because of the permanency of his condition (ie, disk protrusions and compression/chip fracture).

At the time of the MMI rating, the patient continued to suffer from WAD symptoms and was given a final diagnosis of unresolved cervicogenic headaches, cervical, thoracic, and lumbar strains, multiple cervical disk herniations, T7-8 disk herniation, temporomandibular joint dysfunction,

shoulder strain and sprain, and left ulnar neuropathy (cubital tunnel syndrome), all secondary to the motor vehicle crash. The patient continued to display chronic WADs almost 8 months after the initial injury and sought care from a chiropractor who specialized in the Clinical Biomechanics of Posture (CBP) technique as the primary treatment method.

At the time of his initial examination, he complained of ongoing chronic neck pain and stiffness, right arm pain, right shoulder pain, pain between the shoulders, cervicogenic headaches, and constant dull, aching pains progressing to sharp pain with flexion and extension of the cervical spine.

At the initial examination, the patient had a verbal rating scale (VRS) score of 5/10 and a Neck Disability Index questionnaire score of 46%. Orthopedic findings included worsening of pain at end ROM for flexion, extension, and



**Fig 3.** *A, The patient is receiving a Harrison CBP posterior skull translation coupled with extension adjustment. B, The patient is using the Harrison CBP mirror-image exercise of skull posterior translation coupled with extension. C, Extension-compression traction<sup>21</sup> was used for reduction of abnormal head protrusion and cervical curve correction.*

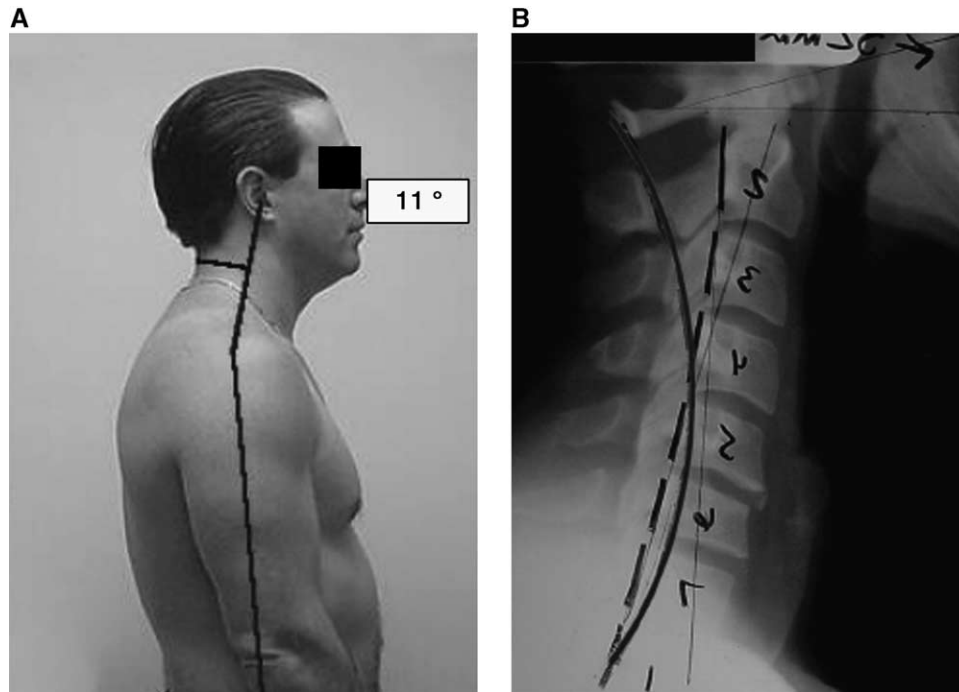
lateral bending. The patient displayed pain in his lower cervical spine and upper thoracic spine with cervical compression tests, whereas decreasing pain occurred on distraction. The reflexes were +2 bilaterally for the upper extremities and dermatomes were equal in sensation. Initial ROM using standard inclinometers showed loss from normal (Table 1).

Imaging results from the prior provider's magnetic resonance imaging (MRI) showed C5/6/7/T1 mild-moderate disk protrusions (Fig 1A). The lateral cervical radiograph showed an anterior head translation of +74 mm, +3° absolute rotational angle drawn on the posterior bodies of C2-7, and a segmental kyphosis at C4/5 of 5°; C5/6 = 10° was measured by use of the Harrison posterior tangent

method (Table 2).<sup>18</sup> Also noted were a chip fracture of C5 and a mild compression of the C6 vertebral body (Fig 1B).

The initial lateral cervical posture analysis revealed a large forward head translation (Fig 2A). The initial lateral cervical plain film evidenced nearly unchanged findings: persistent large anterior head translation (+T<sub>z</sub><sup>h</sup> = 68 mm) and 0° absolute rotational angle from C2 through C7, and a segmental kyphosis at C5/6 measuring +8° (Table 2). Fig 2B shows no significant improvement in the initial lateral cervical view taken compared with the lateral cervical view taken at the prior provider's clinic (Fig 1B).

The patient was treated initially with 10 visits of regional bilateral long-lever cervical spinal manipulation before starting structural rehabilitation care to temporarily decrease



**Fig 4.** A, A significant improvement in the patient's 10-week follow-up of lateral cervical posture. B, The lateral cervical radiograph is shown and evidences marked improvement toward normal. This is for a total of 40 in-office rehabilitation visits.

pain and increase ROM. After this, the patient continued with manipulation only when exacerbation of his pain occurred. After the 10th visit, treatment was changed and included the CBP structural rehabilitation methods of mirror-image drop table adjustments (Fig 3A), mirror-image handheld instrument adjustments, mirror-image isometric exercise (Fig 3B), and mirror-image extension-compression traction (Fig 3C) for the reduction of the abnormal anterior translation posture of the head.<sup>19,20</sup>

For the exercise portion of the rehabilitation, the patient worked initially up to his pain-free ROM, gradually pushing through areas in ROM that were initially painful. He started at 1 set of 10 repetitions holding contractions for 10 seconds into posterior skull translation coupled with slight skull extension and slowly worked up to 5 sets of 10 repetitions holding for 10 seconds each two times per day (Fig 3B).

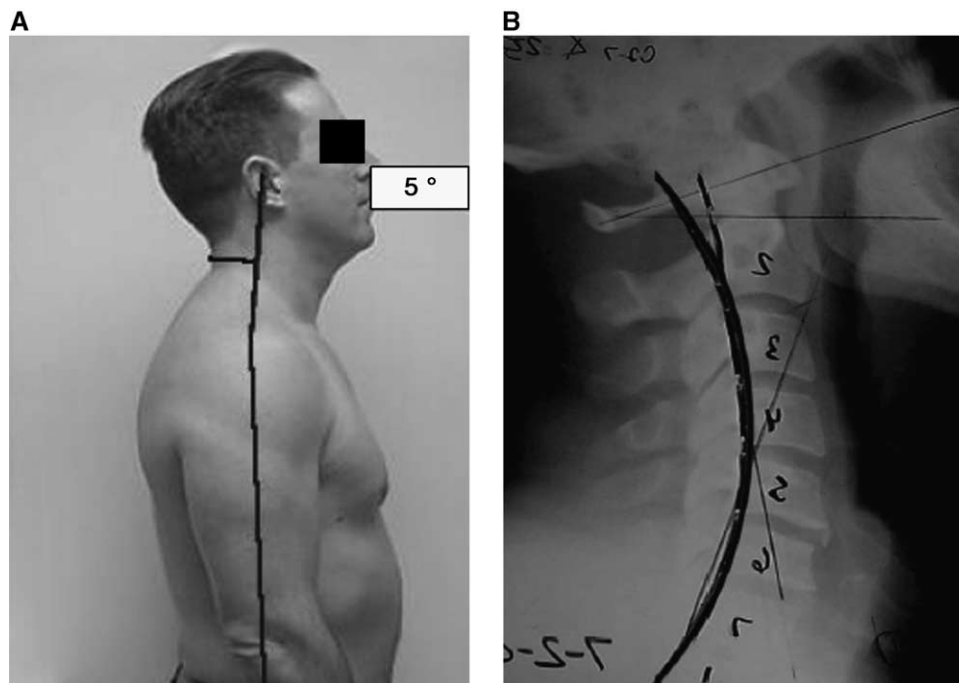
For the traction portion of the rehabilitation, the patient started at 1 minute per session and slowly, over consecutive visits, worked up to 30 minutes of mirror-image extension-compression traction (Fig 3C).<sup>21</sup> The patient's frequency for these rehabilitative treatments was 4 to 5 days per week for 10 weeks. The patient was instructed to perform home exercise as he did in-office and additional home extension-compression traction using a foam wedge two times per week.

Fig 4A and B depict the patient's 10-week follow-up lateral cervical posture and radiograph with 40 in-office rehabilitation visits and Table 2 quantifies the improvements. An improvement in anterior head translation and



**Fig 5.** Because of an improvement in his lateral cervical configuration, the patient was switched to a modified type of two-way cervical extension-compression traction<sup>23</sup> so as to further stress bending toward a normal lordosis.

cervical alignment toward normal<sup>22</sup> was noted. The patient's pain was approximately 80% reduced at the time of first examination and had no cervicogenic headaches. The examination findings showed pain-free end ROMs, cervical



**Fig 6.** A, The patient's 18-week follow-up lateral posture. B, The lateral cervical radiograph. This is for a total of 24 additional visits on the modified two-way extension-compression traction.



**Fig 7.** Magnetic resonance imaging c-spine dated 10/06/01. Mild concentric disk bulging at C4/5 and C5/6 is associated with disc height diminution and desiccation. No evidence of a disc herniation at any level. Mild bilateral foraminal stenosis at C4/5 and C5/6, right greater than the left, is secondary to uncovertebral spurring.

compression tests now displaying negative findings, and only mild cervical tenderness at C5/6 bilaterally upon palpation. The patient reported VRS as follows: pain between the shoulders, 0/10; neck pain, 0/10; headaches, 0/10; midback stiffness, 0/10; low back stiffness, 0/10; neck stiffness, 0/10; and right shoulder pain, 3/10; the Neck Disability Index score was 0% from 46% at the end of care. Cervical ROM showed continued improvement (Table 1).

shoulder pain, 3/10; improvements in cervical ROM were found and are reported in Table 1. The patient elected to continue care although he was significantly improved.

As per CBP protocols,<sup>20</sup> because of the change in the sagittal cervical curvature, the patient was switched to a modified type of two-way extension-compression traction<sup>23</sup> after the second examination (Fig 5). This type of traction modality was performed to further stress bending of the cervical spine toward the normal lordosis. This treatment was performed for an additional 24 visits. After an additional 8 weeks, a second reexamination and radiography were performed. Fig 6A and B show the 18-week posttreatment lateral cervical postural and x-ray examination findings. Table 1 reports these values. A continued correction in the structure of the cervical curve and posture was noted. All orthopedic examination findings were normal with VRS as follows: pain between the shoulders, 0/10; neck pain, 0/10; headaches, 0/10; midback stiffness, 0/10; low back stiffness, 0/10; neck stiffness, 0/10; and right shoulder pain, 3/10; the Neck Disability Index score was 0% from 46% at the end of care. Cervical ROM showed continued improvement (Table 1).

## DISCUSSION

Resolution of chronic WADs following CBP methods as observed in this case is an encouraging development. The most obvious structural objective outcomes were the correction of a persistent, abnormal, anterior head trans-

lation and cervical kyphosis. An interesting finding is the result of the follow-up MRI (Fig 7), which showed that the previous disk protrusions were now only bulges. We are cautious, however, about concluding that the disk herniations improved from our intervention for two reasons. First, the MRI scanners used before and after studies were not the same. Second, the time span between the two imaging studies of 1 year is long enough for spontaneous remission in size to have occurred.<sup>24</sup>

In addition, from this case report, it is evident that cervical ROM continued to improve past the point of resolution of symptoms. Walmsley et al<sup>25</sup> found that placing a subject in an anterior head posture caused significant decreases in the magnitude of axial head rotation. We believe, therefore, that the reason for cervical ROM improvement is related to the concomitant correction in anterior head translation.<sup>25</sup>

We believe that the reason why these WAD symptoms did not resolve before CBP structural rehabilitative treatments methods is that the anterior head carriage and cervical lordosis were not corrected. An anterior head posture has been shown to cause significant increased loads onto the posterior musculature and vertebral bodies.<sup>26,27</sup> Before treatment, the patient initially had 68.0 mm of forward displacement of C1 relative to T1 (Fig 1B), which was unresolved after his earlier course of spinal manipulation and functional-based rehabilitation (Fig 2B). Significantly, in a study of 252 subjects without the presence of neck pain and/or headaches, Harrison et al<sup>22</sup> found that the average displacement of C1 relative to T1 was only 14.86 mm. Therefore, the patient's displacement of 68.0 mm is approximately 4.6 times that of the average pain-free subject.

Cailliet<sup>26</sup> has suggested that if the skull weighs 10 lb, then, for every inch the skull displaces forward, there is an increase of 10 in-lb in the effort needed from the posterior neck muscles to support the weight of the head. However, Clauser et al<sup>28</sup> have shown that the skull is approximately 7.55% of the total body mass. Because the patient in the current report weighs 210 lb, his skull weighs around 15.8 lb. Using the above ratio from Cailliet<sup>26</sup> and the fact that 68.0 mm is equal to approximately 2.75 in, then the patient's muscles must exert an effort of 2.75 in multiplied by 15.8 lb = 43.45 in-lb of effort above normal to support his head and neck under gravity. This increased mechanical load on the patient's muscles appeared to have clinical significance to his neck, upper back pain, and headaches.<sup>26,29</sup>

Similarly, straightening and/or reversal of the normal lordotic cervical curve in our patient can be shown to be a primary cause of his chronic WAD symptoms.<sup>6-11,30</sup> For example, Norris and Watt<sup>7</sup> followed patients involved in motor vehicle accidents for a minimum of 6 months and found that abnormal neck curves "...are more common in patients with a poor outcome." In a 5-year long-term follow-up of 146 patients with whiplash injury, Hohl<sup>9,10</sup> identified cervical kyphosis as a factor predicting a poor outcome.

Furthermore, Foreman<sup>6</sup> argues that after whiplash injury, a kyphotic or military cervical configuration leads to an increased risk factor for future neck pain and disability. Recently, in a prospective study of 110 patients, Kai et al<sup>8</sup> studied the relationship of neurogenic thoracic outlet syndrome (NTOS) to whiplash injury. They found an incidence of cervical kyphosis of 44% to 46% in the patients with NTOS compared with 11% to 24% in the subjects without NTOS. They further concluded that reversal of the cervical lordosis was abnormal and associated with future disability after whiplash. Lastly, according to Kai et al,<sup>30</sup> cervical kyphosis (either segmental or total) leads to total spinal misalignment, rounding of the shoulders, headache, neck pain, scapular pain, and possibly even lower back pain.

The facts that our patient had previous traditional chiropractic manipulation and functional rehabilitative treatments without resolution of his symptoms and was consequently given a permanent impairment rating of 33% are important aspects of this case. Although we agree with this initial line of treatment for pain and ROM improvements, we disagree with care focused solely on symptoms and functional outcomes when structural displacements of the spine and posture exist. In addition, we disagree with decreasing frequency of visits when these structural displacements have not been improved.<sup>31</sup> The patient's lack of improvement in the structure of the cervical spine with manipulative methods is consistent with a previous report on this treatment procedure.<sup>32</sup>

Conversely, the methods used by the chiropractor using CBP in the present case attempted structural restoration of the cervical spine and posture toward the model proposed by Harrison et al<sup>20,22</sup>. Importantly, the outcomes of improved anterior head posture and cervical lordosis found in the present case are consistent with the literature on CBP cervical extension traction methods.<sup>21,23,33</sup> We believe that this case exemplifies the idea that the structure of the spine and posture should be corrected before functional rehabilitation because structure dictates function.

## CONCLUSION

This case illustrates that the patient was not at MMI when his case settled, he was rather at maximum improvement based on traditional approaches to spinal rehabilitation. The patient continued to suffer. After 5 months of CBP mirror-image adjustments, exercise, and extension traction, correction of the patient's sagittal cervical spine and resolution of his chronic WAD symptoms were obtained. Further studies should be pursued to determine the benefits of a rehabilitative approach to treat patient symptoms in chronic WADs while concomitantly correcting the structural displacements of anterior head translation and alterations in cervical lordosis.

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