

Effects of Posteroanterior Mobilization on the Cervical Spine in Patient with Chronic Whiplash–Associated Disorders

The purpose of this case study was to identify the effects of posteroanterior (PA) mobilization on the cervical spine in a patient with chronic whiplash–associated disorder (WAD). The subject of this study was a 58–year–old woman who sustained a chronic WAD as a result of a motor vehicle accident two years prior. The subject has progressively worsening neck pain and stiffness. The subject was determined to have a grade IIb WAD the use of the Modified Quebec Classification. The intervention was central and unilateral PA mobilization on the spinous process of C4 and C5. The PA mobilizations were performed at the end of range to Maitland grade IV. The PA mobilization was conducted once daily for a total of eight days. Two sets of measurements were done one before and one after the intervention. Neck pain, cervical stiffness, range of motion and lordosis of the cervical spine were measured. Experimental intervention decreased the neck pain, and increased the neck stiffness and cervical ROM (range of motion) such as flexion, extension, lateral flexion and rotation. X–ray photographs also represented that cervical curvature increased from 35° to 40°. This study suggested that PA cervical mobilization applied to chronic WAD is effective in decreasing pain, increasing cervical ROM and cervical curvature.

Key words: *Whiplash–associated Disorder; Posteroanterior Mobilization; Neck Pain; Cervical Lordosis*

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INTRODUCTION

Whiplash–associated disorder (WAD) is a common condition that incurs considerable social and economic expense. WAD occurs due to an acceleration–deceleration energy transferred to the neck, usually resulting from a motor vehicle collision¹⁾. The energy transfer may result in a bony or soft tissue injury, which may, in turn, lead to a wide variety of clinical manifestations²⁾. This disease persists leading to pain and disability³⁾. WAD may be a result a hyperextension of the lower cervical vertebrae in relation to a relative flexion of the upper cervical vertebrae, which produces an S–shaped cervical spine at the time of impact⁴⁾. WAD can be classified by five grades of initial severity on the Modified Quebec Classification⁵⁾ (Table 1).

Chronic WAD of more than three month duration

is associated with disturbances in motor function⁶⁾. Chronic WAD is also associated with problems concerning social functioning, daily anxieties and satisfaction with different aspects of life⁷⁾. Patients with chronic WAD have reduced neck mobility, and exaggerated pain after sensory stimulation^{2,8)}. Banic et al. found exaggerated pain following low intensity nociceptive stimulation arising from areas of minimal and undetectable tissue damage or pain⁸⁾. In clinical practice, it is often assumed that patients with chronic pain have increased muscle tension⁷⁾. Other symptoms of WAD are neck stiffness, shoulder pain, paraesthesia, weakness and dizziness⁹⁾.

Early joint mobilization may lead to improved outcomes for WAD patients¹⁰⁾. Recently, joint mobilization has proven to be effective, and is now frequently used in clinics. One of the most common

manual therapy techniques used in cervical spine treatment is posteroanterior (PA) spinal mobilization, as described by Maitland et al.¹⁰. PA mobilization is a manual therapy technique that is commonly used in the examination and treatment of neck pain. It generally involves the application of oscillatory vertical forces over the spinous or transverse process of given vertebra^{12,13}. Physiotherapists usually use their thumbs to apply pressure rhythmically to the vertebrae in a posterior-to-anterior direction¹⁴. The PA force at 1 spinous process causes motion not only of the target vertebra but also the neighboring vertebrae and this mobilization was increase the cervical lordosis¹³. Therapists apply PA mobilization using one of four grades¹⁰. Maitland's grade I and II mobilizations can be performed primarily to decrease joint pain while grades III and IV mobilizations can be used to increase joint ROM¹⁵.

Previous research has generally been focused on lumbar PA mobilization^{16,17}. So far, there has been little discussion about PA mobilization of the cervical spine, and no studies have been conducted regarding PA mobilization in chronic WAD patients. Therefore, this study investigates the effect of cervical PA mobilization on neck pain, stiffness, ROM and cervical lordosis in a chronic WAD patient. To aid in this intervention this study provides X-ray images of the cervical spine.

Table 1. The Modified Quebec Classification of WAD

Grade	Clinical presentation
0	No complaint about the neck, No physical sign
I	Neck complaint of pain, stiffness or tenderness only, No physical sign
II a	Neck complaint and musculoskeletal sign: These include point tenderness but normal cervical range of motion
II b	Neck complaint and musculoskeletal sign: These include point tenderness and abnormal cervical range of motion
III	Neck complaint and neurological sign: These include decrease or absent deep tendon reflexes, weakness and sensory deficits
IV	Neck complaint and fracture or dislocation

METHODS

Subjects

This study is a case study of a single patient with chronic WAD. There is no clinical evidence from computerized tomography or magnetic resonance imaging findings. The lack of objective signs of injury calls for the assessment of cervical dysfunctions such as joint mobility, functional stability, cervical proprioception, and increased muscle tone. A 58-year-old female, with a two-year history of cervical spine WAD gave informed consent to participate in this study. The subject was weighted of 63 kg, and was 166 cm tall. The subject was diagnosed with tension headaches. The patient sustained a whiplash injury in a motor vehicle accident two years prior. After the accident, she developed a headache, neck pain and stiffness. The primary complaint was progressively worsening neck pain and stiffness. The subject was determined to have grade II b WAD by using the Modified Quebec Classification. The subject agreed to participate in the study after receiving explanations regarding the purpose and procedures of the experiment. The subject signed an informed consent statement before participation.

Intervention Methods

The intervention was central and unilateral PA mobilization on the fourth and fifth cervical spine (C4 central, C4 unilateral, C5 central, and C5 unilateral). The mobilization was performed by a physical therapist who completed the Maitland Concept Level 1. The subject was instructed to take a prone position. The therapist performed cervical mobilization on the fourth and fifth cervical (C4, C5) spinous processes (central PA mobilization) and on the fourth and fifth cervical (C4, C5) articular processes (unilateral PA mobilization, right and left side). For unilateral PA mobilization, the first process performed was randomly assigned to either the left or the right side, followed by the opposite side for the second one¹². Four cycles of PA mobilization were performed, fifteen seconds in each segment. The PA mobilizations were performed at the end of range to Maitland grade IV. Maitland's grade IV mobilizations can be used to increase joint ROM¹⁵. Grade IV mobilization can be applied to the restricted part of the joint, against tissue resistance, at small

amplitudes. The PA mobilization was conducted once daily for a total of eight days. Two sets of measurements were taken one before and one after the intervention (9 days).

Neck pain, stiffness, ROM and lordosis of the cervical spine were measured. The assessor of the patient was done blindly. Neck pain was assessed using the visual analogue scale (VAS). The VAS has shown good reliability and validity in WAD patients¹⁸⁾. Muscle stiffness was measured with a Myoton®PRO (MyotonAS, Estonia) over the area located at a 2 cm distance from both sides of the C4 spinous process. To measure the stiffness, the device was positioned vertically on the skin marker, with the patient in a relaxed state in the prone position. Stiffness was measured twice. Mean values were used. In order to assess the cervical ROM, a Goniometer (EZ Read Jamar Goniometer, America) was used to measure flexion, extension, lateral flexion, and rotation. Measurement of cervical ROM was taken when the patient was seated on a static chair. The lordosis of the cervical spine was measured with an X-ray in the sagittal plane. X-ray allowed the subject to be scanned. The subject was scanned in the standing position with neck in the neutral position. In this study, the method of analysis for cervical lordosis was based on the C1–C7 angles of the cervical curve. This procedure involves constructing a line intersecting the anterior and posterior tubercle C1. A second line is then constructed through the inferior aspect of the C7 body. Then, two lines are drawn perpendicular to the first two lines¹⁹⁾.

RESULTS

This study investigated whether central and uni-lateral PA mobilization on the cervical spine could cause structural and functional changes in a chronic WAD patient. The measurements of neck pain, stiffness, ROM and lordosis of the cervical spine are summarized in Table 2.

The VAS score decreased from 5 to 2. The subject mentioned being less uncomfortable in daily life. Stiffness was measured on both sides of the C4 spinous process. The left side stiffness increased from 363.5 N/m to 397.5 N/m, and the right side stiffness increased from 334.0 N/m to 462.0 N/m. Cervical ROM was measured by flexion, extension, lateral flexion (left and right), and rotation (left and right). The cervical flexion angle increased

from 103° to 110° and extension increased from 12° to 17°. The left lateral flexion increased from 15° to 35° and the right lateral flexion increased from 13° to 29°. The left rotation increased from 15° to 33° and the right lateral flexion increased from 16° to 41°.

Cervical lordosis increased from 35° to 40° after the intervention. Figure 1 shows cervical lordosis on an X-ray.

Table 2 VAS, muscle stiffness, ROM and cervical lordosis

Variables	Before	After
VAS (score)	5	2
Left stiffness (N/m)	363.5	397.5
Right stiffness (N/m)	334.0	462.0
Cervical flexion (°)	103	110
Cervical extension (°)	12	17
Cervical left lateral flexion (°)	15	35
Cervical right lateral flexion (°)	13	29
Cervical left rotation (°)	15	33
Cervical right rotation (°)	16	41
Cervical lordosis (°)	35	40

VAS: visual analogue scale; ROM: range of motion

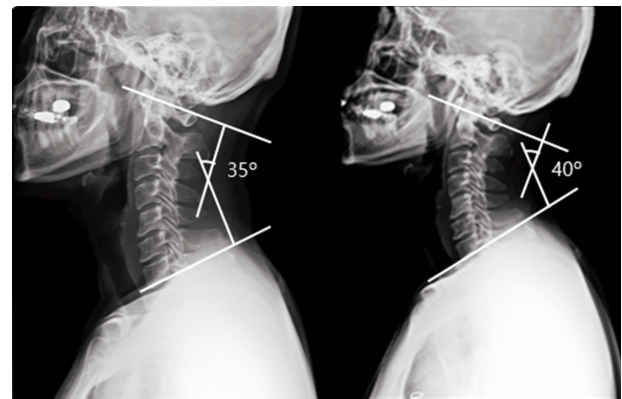


Fig. 1. Cervical lordosis on a X-ray (left: before, right: after)

DISCUSSION

This study is case study applied to one patient with chronic WAD. Among individuals with chronic WAD, about 50% experience continuous symptoms interfering with their daily life²⁰⁾. Faced with a lack of known effective treatments for long-

term pain and disability following whiplash, clinicians have to adopted treatments³. The purpose of this study was to analyze the effect of cervical PA mobilization in chronic WAD patient. The subject of this study was a 58-year-old-female with a two-year history of WAD. The subject was determined to have grade II b WAD. Grade II WAD is defined as the presence of musculoskeletal signs. These musculoskeletal signs manifest as limited ROM putatively due to muscle spasms²¹. There is substantial evidence for the presence of various cervical dysfunctions (increase cervical muscle tone and impaired cervical movement control)²².

Passive movement techniques are commonly used to identify the symptom and can be used as a treatment aimed at increasing mobility or decreasing pain²³. In this study, cervical PA mobilization was applied at spinous and transverse processes (C4 and C5). PA mobilization is frequently used in the assessment and management of spinal problems. The forces applied at spinous processes produce not only movements at the target vertebra but also movements of the entire cervical spine²⁴.

Neck pain and stiffness are the initial main symptoms of WAD. At follow-ups, an average of two years after an accident, 42 percent of individuals had recovered completely, 15 percent had minor discomfort, and 43 percent had minor discomfort sufficient enough to interfere with their capacity for work²⁵.

In this study, the patient's pain score decreased from 5 to 2. This means that PA mobilization had an effect on chronic WAD pain. Passive joint accessory mobilization was used for pain²⁶. In a previous study, joint PA mobilization was effective at decreasing chronic low back pain²⁷. PA central vertebral pressure can be used to treat pain which is evenly distributed to both sides of the lumbar spine²⁸. Although, the subjects were different in the previous study, the results of previous study agree with this study.

In this study, stiffness increased after intervention. Stiffness was measured in the area located at a 2 cm distance from both sides of the C4 spinous process. Shum et al, has suggested that PA mobilization causes immediate desirable effects and reduces stiffness of the lumbar spine of the back pain patients²⁹. This result is inconsistent with the findings of this study. This may be due to the difference in spine region which the two studies were performed. PA mobilization may not be

effective cervical stiffness by WAD. And we may assume that a study period of eight days is not enough for changes in neck stiffness to occur. Further studies could investigate the long-term effect of on PA mobilization on cervical stiffness.

ROM is an effective indicator of physical impairment in the cervical spine. In patients with chronic WAD, cervical ROM was reduced in all primary movements. Specially, flexion and extension movements were the most proportionally reduced in whiplash injury group³⁰. To improve reduced cervical ROM, joint mobilization is known to be effective method³¹. In this result, the angles of cervical spine (flexion, extension, lateral flexion, and rotation) increased after intervention. WAD may occur as a result of hyperextension of the lower cervical vertebrae in relation to a relative flexion of the upper cervical vertebrae¹⁰. Lee et al, found that PA mobilization of the cervical spine generally produced flexion of the lower segments and extension of the upper motion segments¹³. In this study, PA mobilization produced an extension movement of the upper cervical spine. These results suggest that PA mobilization is an effective method of rehabilitation for improving movement in the cervical spine.

In this study, the cervical lordosis angle increased from 35° to 40° after intervention. Cervical posture must be considered during a postural assessment. Marshall & Tuchin (1996) suggested a correlation of reduced cervical lordosis measurements following motor vehicle accident¹⁹. Powers et al, found that PA spinal mobilization consistently caused extension at the tested lumbar segment. Application of PA force on the mid-lumbar vertebrae has the potential to produce extension at all lumbar segments, which can increase the degree of lumbar lordosis²³. This theory may also be applicable to the cervical spine. Lee et al, suggested that the application of PA load produces an extension movement leading to backward bending of the cervical spine. Therefore, cervical lordosis was found to increase with each PA loading cycle¹³. These results indicate that PA mobilization has a positive effect on the cervical posture.

The primary limitations of this study are that it is a single subject study and does not include a control group. However, it is meaningful in that it presented data regarding the neck pain, ROM, and cervical lordosis in a patient with chronic WAD. According to this study's results, central and unilateral PA mobilization of the cervical spine effect neck pain, ROM, and cervical lordosis in chronic

WAD. However, neck stiffness did not show a positive effect. Therefore, future studies should be performed for a longer period with a larger number of subjects. The authors hope that diverse treatment methods using PA mobilization will be used to treat chronic WAD based on the findings of this present study.

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