

Management of Whiplash-Associated Disorder Addressing Thoracic and Cervical Spine Impairments: A Case Report

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Study Design: Clinical case report.

Objectives: To describe a physical therapy program addressing impairments of the upper thoracic and cervical spine region for an individual with a whiplash-associated disorder.

Background: A 32-year-old female with complaint of diffuse posterior cervical and upper thoracic region pain was evaluated 2 weeks following a motor vehicle accident. The patient reported that she was unable to sit for longer than 10 minutes or perform household duties for longer than 1 hour. In addition, she was unable to perform her tasks as a postal worker or participate in her customary running and aerobic exercise activities because of pain in the cervical and upper thoracic region.

Methods and Measures: An examination for physical impairments was performed, including the measurement of cervical range of motion using the CROM device, and the assessment of soft tissue and segmental mobility of the upper thoracic and cervical spine regions. The Northwick Park Neck Pain Questionnaire was used to assess functional limitations and disability. Manual therapy and therapeutic exercises were applied to address the identified impairments. Manual therapy techniques included soft tissue mobilization, joint mobilization, and joint manipulation.

Results: The patient's cervical range of motion was improved and the disability score improved from 25% to 19.5% 3 days after the initial session addressing the thoracic spine. Following a second session also addressing thoracic spine impairments and the use of therapeutic exercises for 7 days, the disability score improved to 11.1%. At the final visit 17 days following the third visit, which focused on addressing the cervical spine impairments, there was complete resolution of signs and symptoms and disability.

Conclusions: Interventions addressing the impairments of the upper thoracic and cervical spine region were associated with reducing pain, increasing cervical range of motion, and facilitating return to work and physical activities in a patient with a whiplash-associated disorder. There is a need for continued research investigating the efficacy of providing interventions to the thoracic spine for patients with whiplash-related injuries. *J Orthop Sports Phys Ther* 2004;34:511-523.

Key Words: manipulation, manual therapy, mobilization, neck, thoracic spine

Whiplash-associated disorders impose a significant financial burden on society. The overall costs, including absence from work, compensation for lost income, litigation, and medical care, are several billion dollars annually.^{1,17} The estimated incidence of these disorders is approximately 4 per 1000 people.^{1,2,6} There is also a high likelihood

(14%-42% of individuals) that the symptoms associated with acute whiplash-associated disorders will become chronic.^{2,6,9,17,22,24,25} Despite the costs, high incidence rate, and risk of chronic disability, there is little available research suggesting a more effective intervention strategy for whiplash-associated disorders.

Studies that compared rest, physical agents, exercise, cervical collar supports, neck care education, transcutaneous electrical nerve stimulation, traction, and manual therapy have not demonstrated 1 intervention strategy to be superior to others at alleviating the symptoms associated with whiplash-associated disorders.^{4,14,15,16,18,23,24,28} However, there are 2 studies that challenge the standard recommendation of rest and cervical collar application following a whiplash injury. Mealy et al¹⁶ found greater improvement in cervical range of motion and pain reduction with early physical therapy intervention utilizing Maitland's system of joint mobilization¹³ when compared to rest and cervical collar application. Additionally, Rosenfeld et al²⁸ had similar findings when utilizing the McKenzie system of repeated active submaximal movements.

In each of these studies, the target region for active and passive mobilization was the cervical spine region. The authors of this case

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report suggest that the inability of most studies to demonstrate the efficacy of manual or exercise interventions for patients with whiplash-associated disorders might be due to the investigators not addressing a potential source or contribution to the patient's symptoms: the upper thoracic spine. It is the authors' clinical observation that patients with neck pain (especially patients with whiplash-associated disorders) tend to respond well to manual therapy and therapeutic exercise interventions addressing the thoracic spine. The relationship of neck pain associated with thoracic spine impairment is consistent with the observations of Refshauge et al.²⁶

In this case report, the authors will use the term *upper thoracic spine* when referring to the upper half of the thoracic spine, that is, the T1 through T6 vertebral levels. This case report will describe the physical therapy management of whiplash-associated disorders with initial interventions targeted at the upper thoracic region followed by the cervical spine.

METHODS

The Northwick Park Neck Pain Questionnaire was administered at the start of every physical therapy session. This questionnaire has been shown to have good test-retest reliability ($r = 0.84$, $\kappa = 0.62$) in patients with acute or chronic neck pain.¹² This questionnaire contains 9 sections which cover activities likely to affect neck pain (eg, sleeping, driving, carrying). Each section contains 5 statements related to the patient's perceived level of difficulty performing the activity of the section. Scores on the questionnaire range from 0% to 100%, with 0% associated with no disability and 100% associated with severe disability. Cervical spine active range of motion (AROM) measurements were taken utilizing the CROM device (Performance Attainment Associates, Roseville, MN) preintervention and postintervention. The CROM device has high intertester and intratester reliability and validity for measuring cervical spine AROM.^{27,30} Cervical spine AROM measurement was performed with the patient in sitting, feet flat on the ground, and both hands on the thighs. The sequence of measurement was rotation, flexion, extension, and lateral side bending with the CROM device used as suggested by the manufacturer. The pain level was assessed using a verbal numeric pain rating scale, with 0 being no pain and 10 being severe pain. This scale has been shown to be reliable and valid.³

History

The patient was a 32-year-old female postal worker who presented to physical therapy 2 weeks following a motor vehicle accident. The patient's car was hit from the rear on the driver's side. The patient sustained a concussion that required overnight hospitalization.

She stated that she lost consciousness and did not recall the details of the accident. In addition to the concussion, the patient's left temporal region sustained minor lacerations, which required sutures and wound care. Cervical radiographs taken at the hospital immediately following the injury were negative for any fractures. The patient was discharged from the hospital the next day with a prescription for pain relief medication. Two days after discharge, the patient saw her primary physician for wound care and complained of constant sharp pain in the upper back, neck, and left shoulder region, as well as nausea and headaches. Her physician prescribed nonsteroidal anti-inflammatory medication as well as muscle relaxants, the use of ice packs, and a soft cervical collar. The patient returned to see her physician 4 days later with continued pain. Her physician recommended continuing the current program of rest, ice, cervical collar, and medication. The patient's pain complaints were unchanged at the 1-week follow-up visit so she was referred for physical therapy with a diagnosis of cervical spine strain.

The Northwick Park Neck Pain Questionnaire and a medical screening questionnaire were administered prior to the physical therapy examination. The physical therapist reviewed the medical questionnaire for possible medical "red flags" to determine if the patient was appropriate for physical therapy services or whether this patient needed referral to another healthcare provider for further evaluation. The patient denied current symptoms of paresthesia, numbness, tingling, dizziness, nausea, vomiting, difficulty swallowing, or radicular pain. She also denied any sleep disturbance or night pain. Thus, the physical therapist's index of suspicion for an underlying, undiagnosed serious pathology was low. The patient reported that she was taking her medication as prescribed by her physician.

The patient reported no prior history of neck, shoulder, and upper back symptoms. Her chief complaint was an intermittent aching-type pain along the posterior aspect of her neck and left upper thoracic region (Figure 1). Her symptoms would arise when sitting longer than 10 minutes and were alleviated by being recumbent for 10 to 15 minutes. She stated that she had discontinued the usage of the cervical collar, as it did not seem to provide any relief. She also reported limited ability to turn her head and look to the left while driving with a pain intensity of 6 out of 10 at the limit of her movement. The pain generated by left neck rotation would subside after returning to a neutral (ie, midline) neck position for about 5 minutes. She was limited to 1 hour of any "upright" household activities. She also reported that she was unable to work or participate in recreational activities secondary to pain. Her neck disability score was moderate on the Northwick Park Neck Pain Questionnaire at 25% (Table 1).

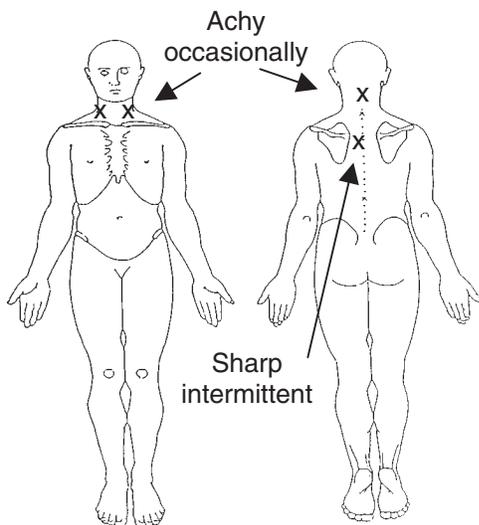


FIGURE 1. Body chart depicting patient's pain location and quality.

The patient's goal was to be able to perform her preinjury work and exercise activities without pain. Her job duties in an 8-hour day involved approximately 3 hours of sitting and approximately 5 hours of standing/walking activities. She described her leisure activities as running and attending aerobic exercise classes twice per week.

Physical Examination

The patient presented in a guarded posture and demonstrated slow cervical spine active movements that were limited by pain. She was limited primarily in cervical flexion. Table 2 displays the initial and follow-up cervical range of motion and pain measurements taken on the patient. Light palpation of the posterior cervical region elicited diffuse pain and protective muscle contractions.

Next, segmental mobility of the upper thoracic spine was examined in flexion and then in extension as described by Flynn.⁷ Care was taken not to strain the soft tissue structures of the cervical spine by limiting end range cervical spine positions during the examination. With the patient in a seated position, the therapist stood behind the patient to examine positional symmetry and the response to unilateral posterior-to-anterior pressures in the region of the right and left T1 to T4 transverse processes.⁷ During this examination, posterior-to-anterior pressures over the area of the left transverse process of T2 and T4, while the upper thoracic spine was flexed, reproduced the cervical and upper thoracic pain reported by the patient. The resistance to movement to the posterior-to-anterior pressure applied in the region of the left T2 and T4 transverse process was greater

TABLE 1. Disability scores at each visit (days [d] following initial visit). The Northwick Park Pain Questionnaire was administered prior to the intervention. Zero percent means no disability and 100% is maximum disability.

	Initial Visit*	3 d	11 d	28 d
Score	25%	19.4%	11.1%	0%

* The initial visit took place 2 weeks after the injury.

than the resistance perceived when the same pressure was applied over the T1 and T3 transverse process on the left and the T1 to T4 transverse process on the right.

There was also palpable hypertonicity of the soft tissue in the region of the left T2 and T4 multifidi. Palpation of these soft tissues, while the upper thoracic spine was flexed, also reproduced the patient's symptoms. During this initial examination, the pain response to palpation at the T4 region was greater than the response at the T2 region. The examiner hypothesized that the impairments in the T4 region were contributing most to the patient's pain complaint and cervical AROM limitations at this time and, thus, the T4 region was the focus of intervention during the first treatment session.

Session 1: Intervention and Outcome

The first intervention immediately followed the initial physical examination. As previously noted, light palpation along the posterior cervical region elicited diffuse pain and protective muscle contraction. Thus, the examiners suspected that further examination or mobilization in the cervical region might exacerbate the patient's symptoms. In addition, at this point in the patient's course of treatment, both soft tissue and joint restrictions in the T4 region appeared to also contribute to the patient's pain complaints and cervical AROM limitation.

Treatment was initiated with soft tissue mobilization applied to the T4 region with the intent to decrease any associated soft tissue restriction in preparation for joint mobilization. Soft tissue mobilization near the left multifidi at the T4 level was performed with the patient in prone (Figure 2). With the therapist positioned facing the patient to the right of the patient's head, soft tissue mobilization was applied in an inferior lateral direction using 3 deep, slow strokes that lasted approximately 30 seconds each.

Manual joint mobilization was then applied while the patient remained in the prone position, but with the therapist at the head of the treatment table. With this technique, using the therapist as reference, the thenar eminence near the scaphoid of the therapist's right hand applied a right-to-left stabilizing force to the T5 spinous process. The hypothenar eminence near the pisiform of the therapist's left hand applied a left-to-right translatory force to the spinous process



FIGURE 2. Application of soft tissue mobilization in an inferiorlateral direction near the left multifidi at the T4 level in prone.

of T4 for 2 bouts of 30 repetitions. Each repetition was performed into the end range resistance of T4 segmental motion (Figure 3). To assess whether the patient demonstrated changes in cervical mobility or pain after the mobilization, the patient's cervical AROM was reassessed in sitting. Because observable improvements in cervical AROM and a reduction in the level of pain were noted following the first 2 bouts of mobilization, the same spinal mobilization procedure was repeated for 2 more bouts. Afterward, reassessment of cervical AROM using the CROM device was performed, demonstrating increased AROM and decreased pain, especially for cervical flexion (Table 2).

The patient was instructed in 2 upper thoracic therapeutic exercises to be performed at home with the intent to maintain or improve the cervical flexion mobility gained during the first intervention session. For the first exercise, the patient was prone over a towel with the thickness of the towel adjusted to promote passive upper trunk flexion (Figure 4). This position was to be taken 2 times per day for 10 minutes each session. The second exercise was performed with the patient actively flexing the upper trunk in a quadruped position (Figure 5). The patient was to perform this exercise twice a day with 3 sets of 10 repetitions per session. The patient was instructed to stop these exercises if symptoms were exacerbated.

Session 2: Intervention and Outcome

On the second physical therapy visit, which occurred 3 days after the initial visit, the patient reported that she was now able to drive and sit without any pain throughout the day. Her neck disability score was now 19.4% compared to 25.0% at initial evaluation (Table 1). Cervical AROM measurements using the CROM device indicated 10° to 14° improvement with left rotation, left side bending, and right side bending with 2-3/10 pain at end-of-range (Table 2). Flexion motion continued to be restricted with 4/10 pain, which occurred during midrange of motion. During the re-examination of the patient's upper thoracic region, increased resistance to

TABLE 2. Cervical spine active range of motion (AROM) in degrees and pain level at the end of AROM preintervention and postintervention for each physical therapy session addressing the thoracic spine. Pain was measured with a verbal analog scale where 0 indicated no pain and 10 indicated severe pain.

	Preintervention		Postintervention	
	AROM	Pain Level	AROM	Pain Level
Initial visit				
Flexion	32	6.0	50	4.5
Extension	60	4.0	68	5.0
Left side bending	24	6.0	36	6.0
Right side bending	30	5.0	38	4.5
Left rotation	62	6.0	66	4.5
Right rotation	70	0.0	70	0.0
3 d following initial visit				
Flexion	40	4.0	60	0.0
Extension	60	4.0	60	3.0
Left side bending	36	3.0	34	4.0
Right side bending	44	3.0	50	0.0
Left rotation	72	2.0	76	3.0
Right rotation	70	3.5	78	0.0
11 d following initial visit*				
Flexion	56	3.0	68	2.0
Extension	70	3.0	72	0.0
Left side bending	30	3.0	30	3.0
Right side bending	40	0.0	48	0.0
Left rotation	68	3.0	74	3.0
Right rotation	68	3.0	74	3.0

* Following intervention to the thoracic spine.

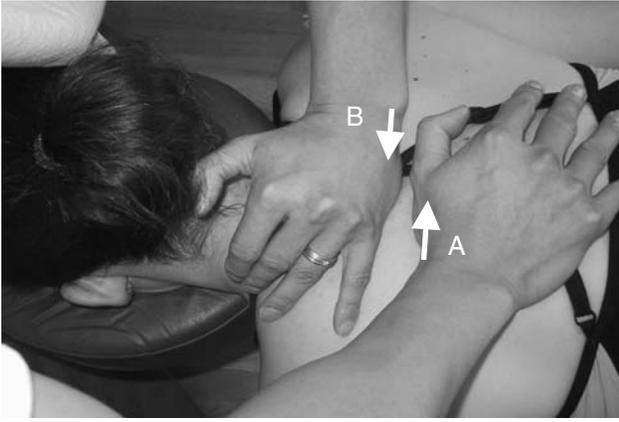


FIGURE 3. Application of joint mobilization intended to improve right rotation of T4 with the thoracic spine in the flexed position. Using the therapist as reference: (A) the thenar eminence near the scaphoid of the therapist's right hand applied a right to left stabilizing force to the T5 spinous process; (B) the hypothenar eminence near the pisiform of the therapist's left hand applied a left to right translatory force to the T4 spinous process.



FIGURE 4. Passive range of motion exercise to improve upper thoracic flexion. The patient's head was positioned for comfort. The thickness of the towel was adjusted to promote passive upper trunk flexion.



FIGURE 5. Active range of motion exercise to improve upper thoracic flexion. The upper thoracic spine is actively flexed until a stretch is felt along the upper thoracic region where the patient was treated.



FIGURE 6. Application of manipulation intended to improve right rotation and right side bending of the T2 segment relative to the T3 segment while the thoracic spine was in flexion.

posterior-to-anterior pressures applied over the region of the left T2 and T4 transverse processes while the upper thoracic spine was in flexion was still noted. However, during this patient visit, the T2 segment appeared to offer most resistance to manual pressures and was also the segment that most easily reproduced the patient's current symptoms.

Soft tissue and joint mobilizations were applied to the T2 segment with the same technique and repetitions that were provided to T4 during Session 1. Afterward, with the patient sitting, minimal changes in cervical AROM were observed. A second bout of mobilization techniques was performed, again, with no improvement observed in cervical AROM. In addition, the resistance to posterior-to-anterior pressures over the left T2 transverse process was not lessened.

At this point, T2 joint restriction appeared to contribute the most to the patient's pain complaint and cervical AROM limitation. The lack of improvement of the localized tissue resistance prompted the examiner to implement a high-velocity, low-amplitude thoracic manipulation. The manipulation was applied with the intent to improve the right rotation and right side bending of the T2 segment relative to the T3 segment while the thoracic spine was in flexion⁷ (Figure 6). The manipulation procedure was performed in supine, taking care to maintain the cervical spine in a relatively neutral, midrange position. Following this manipulative procedure, cervical AROM increased and pain with cervical motion was reduced (Table 2).

During this visit, the exercises provided during the first intervention session were reviewed. The patient demonstrated good performance of the exercises. At this point, it was felt that the patient would benefit



FIGURE 7. Exercise to promote cervical, upper thoracic, and scapular stabilization. The patient stood against a wall with the cervical spine placed in a “chin tucked” position. The thoracic spine and upper extremities are maintained against the wall while both shoulders are moved from starting position of approximately 60° of shoulder abduction up to 130° and then back to starting position.

from an additional exercise intended to promote cervical, upper thoracic, and scapular region stabilization. The patient was instructed on an exercise, as described by Sahrman,²⁹ that entails the patient standing with the thoracic spine against a wall and the cervical spine placed in a “chin tucked” position. With this exercise, the shoulders are abducted and externally rotated to also bring the upper extremities against the wall (starting position), and then both shoulders are moved into abduction (up to about 130°) and back to the starting position (Figure 7). The use of this exercise to promote, among other muscles, the recruitment of cervical stabilizers is consistent with the work by Jull,¹¹ who found impairments of the deep cervical flexor muscles in patients who sustained whiplash injuries.

Session 3: Intervention and Outcome

At the third visit, 1 week later, the patient reported that she decided to return to work due to the reduction in her symptoms. Thus, the patient returned to work 2 weeks earlier than the original recommendation of her physician. Her neck disability score was now 11.1%. Her chief complaint at this visit was neck soreness that she experienced at the end of the day. She also reported that she had not yet returned to running or participating in her aerobic exercise class because she was afraid that exercise would aggravate her symptoms. The patient exhibited limited cervical spine left side bending and experienced end range pain with cervical spine flexion and rotation (Table 2). Mild resistance to posterior-to-anterior pressures over the area of the T4 and T2 left

transverse processes was noted. However, there was only mild reproduction of the patient’s symptoms during this visit and stronger manually applied pressure was needed to elicit the pain reproduction when compared to the previous 2 visits.

The soft tissue mobilization, joint mobilization, and joint manipulative procedures directed at the upper thoracic spine performed during the previous 2 sessions were repeated. Reassessment following implementation of these procedures did not reveal significant reductions in the reported levels of pain during cervical AROM. The examiner decided that the benefits of treatment directed to the thoracic spine had diminished. The examiner then decided to assess the mobility and the movement-pain relationship of the cervical spine.



FIGURE 8. Procedure to assess the superior/anterior glide of cervical segments. The distal interphalangeal joint of the index finger makes contact with the arch of the cervical segment to be examined. Then a superior/anterior glide is applied to assess for resistance and symptom response.



FIGURE 9. Procedure to assess the inferior/posterior glide of cervical segments. The proximal interphalangeal joint of the index finger makes contact with the arch of the cervical segment to be examined. Then an inferior/posterior glide is applied to assess for resistance and symptom response.

TABLE 3. Cervical active range of motion (AROM) and pain level posttreatment of cervical spine and at reassessment on day of discharge.

	Postintervention	
	AROM	Pain Level
11 d following initial visit*		
Flexion	68	0.0
Extension	72	0.0
Left side bending	38	2.0
Right side bending	48	0.0
Left rotation	74	2.0
Right rotation	74	2.0
28 d following initial visit		
Flexion	64	0.0
Extension	80	0.0
Left side bending	44	0.0
Right side bending	46	0.0
Left rotation	68	0.0
Right rotation	70	0.0

* Following intervention to the cervical spine at the third physical therapy session.

During the cervical spine examination, the patient was placed supine and the physiological and accessory motions of the cervical spine were examined. The therapist was positioned at the head of the treatment table with each hand on 1 side of the patient's cervical spine. The therapist examined the superior/anterior and inferior/posterior mobility of C2-3, C3-4, C4-5, C5-6, and C6-7 (Figures 8 and 9). During these procedures, the distal interphalangeal joint of the index finger made contact with the arch of the cervical segment to be examined on one side. The therapist then applied a superior/anterior glide to assess for resistance and symptom response of each segment. The same procedures were then applied with a posterior/inferior glide. Abnormal resistance to manually applied posterior/inferior pressures in the region of the left C6-7 zygapophyseal articulation was noted. Palpatory provocation of this region also reproduced the patient's current pain complaint. The examiners hypothesized that the impairments in this motion segment were contributing to the patient's current pain complaint and cervical AROM limitations, thus, became the focus of intervention.

A contract-relax procedure intended to create superior/anterior motion at the left C6-7 segment was first implemented. The intention of this procedure was to decrease any potential joint and soft tissue dysfunction that was associated with this patient's motion impairment.^{5,10} During this procedure, the therapist flexed the patient's neck and used his right hand to translate the C6-7 motion segment laterally from right to left with the intention of improving C6-7 flexion and right side bending (Figure 10). The patient was cued to contract the muscles causing left side bending for 3 seconds and then relax. During the relaxation period, the therapist provided a manual stretch intended to improve flexion and right side bending for approximately 3 seconds. This contract-relax cycle was repeated 6

times. This procedure was then followed with 6 repetitions of a contract-relax procedure intended to create a posterior/inferior motion at the left C6-7 segment.^{5,10} During this procedure, the therapist's extended the patient's neck and used his left hand to translate the C6-7 motion segment laterally from left to right with the intention of improving C6-7 extension and left side bending (Figure 11). Assessment of the patient's symptoms following this procedure indicated a reduction in the pain level with cervical flexion and an increase in left side-bending AROM (Table 3).

In addition to the manual intervention provided during this third session, performance of the 3 exercises that the patient was utilizing was reviewed. Minor corrections in the performance of the exercises were provided for the patient and she was then instructed to continue the exercises until the next visit.



Figure 10. Contract-relax procedure to create superior/anterior motion of the left C6-7 segment. The therapist flexed and translated the C6-7 segment laterally to the left. When cued, the patient contracted the muscles that create left side bending for 3 seconds and then relaxed. The procedure is repeated 6 times.



Figure 11. Contract-relax procedure to create inferior/posterior motion of the left C6-7 segment. The therapist extended and translated the C6-7 segment laterally to the right. When cued, the patient contracted the muscles that create right side bending for 3 seconds and then relaxed. The procedure is repeated 6 times.

Session 4: Intervention and Outcome

At the fourth visit, 2 weeks later, the patient reported that she had no pain or functional limitations and had returned to running and aerobic activities. Her neck disability score was 0%. Segmental mobility of the upper thoracic and cervical areas was re-examined. Resistance to posterior-to-anterior pressures applied in the region of T4 and T2 transverse processes was considered normal and did not provoke pain. Similarly, palpation of the myofascial structures indicated the absence of dysfunction and was pain free. Posterior/inferior pressures in the region of the C6-7 zygapophyseal articulation, with the patient supine, did not produce pain and normal resistance to movement at end range was noted. Cervical AROM was measured again using the CROM device indicating normal and pain-free motion (Table 3). The patient was discharged as she met her goals. She was encouraged to continue participating in her current physical fitness activities.

DISCUSSION

This case report describes a patient who had a clinical presentation suggestive of a whiplash-associated disorder. The physical examination revealed mobility impairments of 2 upper thoracic spinal segments. Intervention intended to normalize the upper thoracic impairments were associated with alleviating a great proportion of the patient's cervical mobility impairments as well as the neck pain that was related to the patient's reported functional limitations and disability. This is consistent with an abstract on a study by Flynn et al,⁸ who reported pain reduction and cervical AROM improvements following manipulation to the upper thoracic spine. Their

study included 26 subjects who were primarily reporting neck pain and 4 patients who had a clinical presentation of cervical radiculopathy.

In this case report, the patient returned to work 3 weeks following her motor vehicle accident. In addition, she reported that her symptoms were resolved completely 6 weeks after her accident. She received 4 physical therapy sessions. The return to work time and the time required for the symptoms to resolve for this patient was shorter than the results typically reported in the literature for patients sustaining whiplash-associated disorders.^{6,9,23} Cumulative results comparing interventions for patients who were treated with rest, physical agents, medications, exercise, cervical collar supports, neck care education, transcutaneous electrical nerve stimulation, traction, and manual therapy, have shown continued residual cervical ROM limitations and pain symptoms at 6 weeks, with 14% to 42% of patients reporting symptoms for more than 2 years.^{4,14,15,16,18,23,24,28} Though a case report prevents establishing a cause-and-effect relationship, the rapid recovery in this patient may be partially attributable to the interventions applied to the upper thoracic spine impairments.

The patient was noted to have almost complete resolution of cervical ROM limitations and pain symptoms after 2 sessions addressing thoracic spine impairments in a period of less than 2 weeks (approximately 4 weeks from the date of the MVA). Complete resolution was noted at the fourth session, approximately 6 weeks after the original date of the MVA. Mealy et al¹⁶ also found improvement in cervical ROM and pain reduction by addressing cervical impairments utilizing Maitland's system of joint mobilization.¹³ Rosenfeld et al²⁸ had similar results when utilizing the McKenzie system of repeated active submaximal movements. However, for both studies, cervical limitations and pain symptoms were still noted at 6 weeks and at 6 months.

The results of this case report suggests that segmental mobility impairments of the upper thoracic as well as the cervical spine should be assessed in patients with functional limitations associated with neck pain. This is consistent with the work of Norlander and associates,^{19,20,21} indicating that limited cervicothoracic segmental mobility was related to the development of neck and shoulder pain. Future research is needed to further explore the efficacy of addressing upper thoracic spine impairments for patients with primary neck pain or whiplash-associated disorders.

CONCLUSION

Patients with whiplash-associated disorders often present with diffuse neck, thoracic, shoulder, and arm pain. This poses a dilemma when determining whether to treat the cervical spine or thoracic spine region. This case report suggests that the upper

thoracic region may be a potential source of symptoms in an individual suffering of neck pain and reduced range of motion following a motor vehicle accident. Manual therapy and exercises addressing the impairments of the upper thoracic region, as well as the cervical area, were associated with a rapid reduction in symptoms and disability in the patient described in this case report. Clinicians should consider including evaluation and interventions for the thoracic spine when treating a patient with whiplash-associated disorders. Continued research that investigates the efficacy of interventions to the thoracic spine in patients with whiplash-associated disorders is needed.

ACKNOWLEDGMENTS

The authors would like to acknowledge Chris Powers, PT, PhD, for his contributions as a consultant and reviewer of this report.

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Invited Commentary

This case report by Pho and Godes makes an important and interesting contribution to management of a complex condition that is often frustratingly difficult to treat. It is essential to publish observations on single cases such as this, because they help to shift the frontiers of knowledge, and indeed, occasionally, the whole paradigm of knowledge. This case report is likely to contribute to such a shift. The report is well written and in general very logical. The authors are appropriately cautious in their conclusions and do not make extravagant claims, and the intervention is based on a thorough examination.

Despite the existence of guidelines for the management of whiplash-associated disorder (WAD), many therapists do not apply the recommended interventions, and few interventions offer rapid relief, except, perhaps, in the least severe grade of WAD. The patient presented in this case report most likely had a grade 2 WAD because she had neck complaints and musculoskeletal signs, but no neurological signs.^{5,6} However, her hospitalization after the accident because of the blow to her head, indicates a need for radiographs and further monitoring to ensure that she did not suffer a fracture/dislocation (grade 4 WAD). Guidelines for physical therapy management for WAD grade 2 recommend use of reassurance, advice to return to normal activity as soon as possible, and can include exercise, spinal manual therapy, traction, and multimodal treatment when relevant.⁶ The treatments provided in the case report include some of these options.

It is possible that the rapid positive outcome observed in this case report is due to the inclusion of thoracic mobilization; however, when comparing their work with others, the authors need to record the stage of WAD of their own case, and the stage studied by others, and also note any prognostic indicators. It would be expected that cases with few indications of poor prognosis should recover more rapidly than cases with many factors indicating poor prognosis. This also leads to consideration of the natural course of WAD, with some studies reporting an incidence of longlasting pain as very low, with high incidence of rapid natural recovery,¹ although others have noted a higher incidence of persistent pain.⁴ The authors are appropriately restrained in claiming efficacy for their intervention; but with the knowledge of the potential for rapid recovery, this case provides incentive to conduct a rigorous randomized controlled trial to determine the efficacy of this treatment approach.

The Case Presentation

The patient, a postal worker, presented 2 weeks after a motor vehicle accident with WAD (most likely

grade 2). She had pain in the cervical and thoracic regions, and in her shoulder. Unfortunately, no mention is made of the shoulder after the initial examination. It would be interesting to know whether the shoulder pain abated at the same rate as the neck pain. Quite commonly, shoulder pain is related to neck pain and reduces at the same rate or more quickly than the neck pain with treatment directed at the neck. This has not been clearly documented or noted clinically with thoracic spine treatment. It is unfortunate that we don't know if the shoulder pain decreased with treatment directed at the thoracic spine—this would be extremely interesting. Some reassessment data would be helpful to highlight this phenomenon.

The outcome was clearly excellent and more successful than predicted, at least by the referring physician. Nevertheless, some questions arise in my mind about the specific details of the interventions. For example, the treatment of the cervical spine appeared somewhat indirect, using contract-relax techniques with a purpose that has not been investigated for validity. Why not use the same mobilization techniques used to assess and identify cervical joint mobility impairments? The selection of transverse mobilizations as a treatment for the thoracic spine was similarly puzzling to me when segmental mobility was assessed in a posterior-anterior direction.

I would expect to see a patient with this clinical presentation about every second day at this early stage and I am intrigued that the therapist left a week between visits. This is an interesting issue and worth exploring further. Maybe it is more appropriate to treat such patients on a weekly basis, with a home program of exercises to continue between these less frequent visits.

It is unclear to me why some of the interventions were included: eg, manipulation was performed to improve rotation and side bending of an individual thoracic spine segment. This is not likely to be plausible biologically and our understanding of manual palpation is that we cannot reliably detect such segmental abnormalities. I also wonder about the possible relevance or relationship to the patient's original goals. I was also slightly puzzled that exercises which are essentially scapular stabilization exercises were used to address the deep cervical flexor muscles. This is a very indirect method of recruiting the deep neck flexor muscles and the method proposed by Jull et al² may be more potent for this outcome. It would also be helpful to have information on dose of exercises and choice of exercises, and the reasoning underpinning these decisions.

Other Comments

An interesting issue arising from this case report is that the excellent functional outcome does not appear to correlate with a change in cervical range of movement measurements (Table 2). There was not a consistent improvement in any direction of movement from baseline to 11 days postbaseline measurement. Our research group also found, in a recent study, that function and pain were much more responsive to change than any measurement of impairment in patients with low back pain.³ This highlights the importance of specific functional goals. It also shows the importance of defining specific goals for the patient (for example, being able to reverse the car), rather than a general goal about returning to usual lifestyle without pain.

Because it is worth researching the treatment approach further, it would be helpful for the authors to pose some physiological basis for their observations. It is not essential to understand the physiological basis prior to demonstrating treatment efficacy, but the treatment should have biological plausibility.

It would also be useful for the authors to give some indication of when to choose thoracic spine intervention instead of directing treatment at the more obviously involved cervical spine.

My own clinical observations are that this is a very interesting approach to treatment that reminds me of the several patients with WAD that I have treated who were in too much pain to be touched locally at the cervical spine. Any physical contact, even the most gentle, stimulated an autonomic response of nausea and other signs and symptoms. In these patients perhaps the thoracic spine might have been a useful place to commence treatment. In my own practice, when treating patients with cervical spine dysfunction,

I have rarely used the thoracic spine as a starting point; however it is becoming more accepted with more colleagues experimenting with this approach.

As the authors clearly note, the results from this initial observation cannot be generalized. I look forward to rigorous testing of this interesting treatment approach.

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Author Response

We wish to cordially thank Dr Refshauge for her insightful comments. Her thoughtful review establishes a forum for a stimulating dialogue on the management of a complex condition. The following is our response to questions and concerns raised by Dr Refshauge.

We are in agreement with Dr Refshauge that few interventions offer rapid relief for many of the cases of whiplash-associated disorder (WAD). What we would like to propose investigating is the possibility that the lack of success of the traditional approach for certain patients is that the intervention may be applied to the region of the spine that is not the source of the pain-related disability. In addition,

guidelines^{17,20} often focus the interventions on improving mobility in the commonly hypermobile cervical area,^{1,8,12,18,19} instead of improving mobility in the commonly hypomobile upper thoracic region and promoting stability in the cervical region. Perhaps a classification model for patients with cervical and shoulder pain based on physical impairments may provide improved outcomes for patients with upper quarter musculoskeletal disorders in the same manner that classification-based physical therapy has been effective for acute low back pain.⁶ We believe that classification models for patients with cervical and shoulder pain could be a valuable focus of future research.²¹

We also agree with Dr Refshaug that including indicators of the stage, severity, and prognosis are important in determining the efficacy of treating the upper thoracic spine in patients with complaints of cervical and shoulder symptoms. In this patient, the shoulder pain did, indeed, resolve prior to the resolution of the cervical symptoms and she was able to perform all of her occupational and recreational tasks without restriction at the time of discharge.

In regard to the selection of mobilization techniques, contract-relax interventions were used for the cervical spine because it was suspected that the pain-limited mobility was due to a potential intra-articular zygapophyseal entrapment^{4,9,13} that may have been more appropriately addressed with multiple isometric muscle contractions at the extremes of available pain-free ranges of motion,^{2,7} rather than with the passive accessory or physiologic motions tests that are useful in identifying the involved cervical segment. We acknowledge that there is limited evidence supporting the biological plausibility or clinical efficacy of the chosen cervical manual therapy procedures.

On the issue of the frequency of physical therapy visits, we agree that comparing more frequent with less frequent patient visits would be interesting to explore. This patient is a member of a prepaid health plan and once-per-week treatments are common for patients with acute conditions and even less frequent treatments are common for subacute or settled conditions. In this healthcare system, instructions in self-care and exercises are a common focus for initial and subsequent patient visits.

On the question of exercise selection, we again were focusing on improving the upper thoracic position in relation to the lower thoracic/lumbar spine and pelvis rather than isolating the deep neck flexors. The patient was instructed to perform these exercises twice a day with 3 sets of 10 repetitions per session. The patient was instructed to stop these exercises if symptoms were exacerbated. The manipulation procedure was chosen as a progression of the mobilization techniques to achieve the same purpose. We acknowledge that there is limited evidence supporting the biologic plausibility of the chosen thoracic manipulation procedure. However, there is evidence for the reliability of detecting segmental abnormalities.¹⁰

In regard to the lack of correlation between the functional outcome and change in cervical ROM impairment, we have found that the change in segmental motion correlates better with a change in function than does overall range of motion, especially in patients following a motor vehicle accident where cervical instability may be present. One potential physiological explanation for the positive outcome observed in this case is that improving the mobility of the hypomobile and painful upper thoracic area would lessen the need for the involved midcervical

segments to function at or near their end range and potentially painful motion ranges. Another consideration is that the pain referral patterns in the upper thoracic, cervical, and shoulder girdle region are to some extent overlapping.^{3,5,14} Also, biomechanical studies have challenged the traditional thought of the cervical hyperextension mechanism in WAD. Studies found that during the initial phase of a whiplash-type injury, the lower cervical zygapophyseal joints go into hyperextension with the upper cervical segment goes into flexion.^{11,15} Thus, the motion is similar to a chin-in type of movement in the cervical spine and a corresponding extension movement in the upper thoracic spine. The authors of this case report suggest that this chin-in mechanism may also create an injury in the upper thoracic spine. This mechanism may have been a precipitation factor creating the upper thoracic impairments exhibited in the patient in this case report. This chin-in mechanism may also explain the results of the study by Rosenfeld et al,¹⁶ where earlier mobilization exercises that included chin-tuck exercises resulted in earlier recovery. Rosenfeld et al¹⁶ may have been addressing impairments in the upper thoracic region with this exercise. Thus, it seems logical that if postural alignment and mobility in the upper thoracic spine are improved, then there may be a decrease in the stress applied to the cervical structures while performing normal daily activities.

Thus, we believe that in patients with cervical and shoulder pain complaints, upper thoracic segmental mobilization or manipulative therapy is indicated when upper thoracic segmental mobility testing, such as posterior-to-anterior pressures, reproduce the patient's reported pain complaints at rest or with active cervical or shoulder motions. In addition, we concur with the suggestion of Dr Refshaug, that patients with acute, irritable cervical symptoms may be best managed by using thoracic spine interventions as a starting point. We also look forward to future research that would provide more rigorous testing of the treatment approach utilized with the patient in this case report.

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