Use of a multimodal conservative management protocol for the treatment of a patient with cervical radiculopathy

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Abstract

Objective: The purpose of this study is to describe and discuss the treatment of a cervical disk herniation using a sequential multimodal conservative management approach.

Clinical Features: A 40-year-old man had complaints of headache and severe sharp neck pain radiating to his left shoulder down to his arm, forearm, and hand. Results of electromyography/nerve conduction studies were abnormal. Magnetic resonance imaging revealed a large disk protrusion at C5-C6 with indentation of the thecal sac and a spur at the posterior margin. Moderate left neural foraminal narrowing was present at C5-C6 with narrowed intervertebral disk space at C5-C6 and C6-C7.

Intervention and Outcome: High-velocity, low-amplitude chiropractic manipulation; electrotherapy; ice; and exercise were used for treatment. The Neck Disability Index was used as a primary and electromyography/nerve conduction studies as a secondary outcome measurement. Based on the Neck Disability Index, there was an overall 89.65% symptoms improvement from the baseline.

Conclusions: This case study demonstrated possible beneficial effects of the multimodal treatment approach in a patient with cervical radiculopathy.

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Introduction

Neck pain is a very common problem, second only to low back pain in its frequency and time off work; and

it is the second most frequent ailment seen in musculoskeletal practice.¹ It arises from a variety of nonspecific musculoskeletal causes, including direct trauma, progressive structural changes with or without associated systemic disease (eg, rheumatoid arthritis), chronic stress or strain injury, and degenerative conditions.² It is usually a persistent and recurrent complaint that is associated with considerable disability and cost to society.³ The prevalence of neck pain is approximately 13%,⁴ with a lifetime prevalence of

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nearly 50%.⁵ Cervical radiculopathy (CR) is a distinct consideration in the evaluation of any patient who has neck pain.⁶ Cervical radiculopathy is largely a clinical diagnosis⁷ and refers to any disease process that causes the impairment of cervical nerve roots⁸; its hallmark clinical manifestations are pain, sensory loss, and motor weakness in the distribution of the affected nerve root.⁹ It is thought to represent 5% to 36% of all radiculopathies.¹⁰ The most common cause of CR is a herniated cervical disk, followed by cervical spondylosis.¹¹ Radicular pain is believed to be caused by activation of sensory fibers at the level of the dorsal root. It is described as a thin band of sharp shooting pain along the distribution of the nerve(s) supplied by the affected dorsal root. It is often accompanied by paresthesia, hypoesthesia, or decreased reflexes, and may be coupled with motor weakness secondary to compromise of the ventral roots.¹² The incidence of CR is estimated to be approximately 85 per 100 000 people, with a higher rate in men than women (107.3 per 100 000 vs 63.4 per 100 000, respectively) and peak incidence in the sixth decade of life in both sexes.¹³ Several studies demonstrate that only a small percentage of patients with CR require surgery.^{14,15} Most patients make a full recovery or are only minimally symptomatic after conservative treatment.¹⁶⁻¹⁹

This case report describes an approach consisting of multimodal conservative management for CR using high-velocity, low-amplitude chiropractic manipulation; electrotherapy; ice; and exercises. The Neck Disability Index (NDI)²⁰ was used as a primary outcome measure; and electromyography (EMG)/nerve conduction studies (NCS), as a secondary outcome measure. The NDI is a simple, reliable,²¹ valid,²² sensitive, and specific²³ assessment and can be used in patients with CR.²⁴

Case report

Patient history

A 40-year-old business man presented with complaints of headache and severe sharp neck pain radiating to his left shoulder, arm, and forearm. Previous medical history revealed that his problem started with a feeling of weakness in his left shoulder and arm approximately a year and a half earlier when he got up from bed; he had no history of trauma to cervical spine or any signs or symptoms the night before. Gradually, over the next 3 days, the feeling of

weakness over his left shoulder and arm changed to the searing pain. The pain felt as if a nail or screw was being drilled into the back of his neck and left shoulder. At the same time, he felt tingling and numbness throughout the left side up to the tip of his fingers. Because of the severity of his pain, he visited an orthopedic medical specialist within the week. He was prescribed a nonsteroidal anti-inflammatory drug, 2 cortisone shots intramuscularly, and 10 sessions of physiotherapy; a 4-view cervical radiograph series was also taken.

Three days later, because of increased pain, he visited a neurologist. He was told to discontinue the previous treatment protocol; and a magnetic resonance image was obtained (Figs 1-4), revealing a large disk protrusion at C5-C6 with indentation of the thecal sac and a spur at the posterior margin. Moderate left neural foraminal narrowing at C5-C6 and narrowed intervertebral disk space at C5-C6 and C6-C7 were noted. Upon the patient's refusal of surgery, he was prescribed

Fig 1. T2-weighted sagittal image. Note disk herniation at C5-6.

Fig 2. T2-weighted sagittal image. Disk herniation at C5-6 and C6-C7.

an over-the-door traction device with a 3-kg weight bag to use for 12 to 16 hours each day under the direction of physical therapists, in intermittent format, with traction applied for 45 minutes, followed by 15-minute

intervals with no traction, along with 45 sessions of close supervision physiotherapy over a 2-month period. The rest of the day, the neurologist recommended that he use a cervical collar (Philadelphia type). In addition to his 2 EMG/NCS (performed 1 and 5 months after the onset of symptoms) (Tables 1-2), he had consulted 2 other orthopedists and 1 neurologist, all of whom suggested surgery. All of the treatments appeared to be unhelpful, and his condition was deteriorating.

In his current health history, he related numbness in the lateral side of his left arm, forearm, and hand, with the emphasis especially in the first 3 digits anteriorly and posteriorly. The sharp pain was aggravated by minimal flexion or extension and changed to a searing pain radiating down through the neck to the arm upon movement, with intermittent stiffness in the midback. These symptoms resulted in difficulties with his normal sleeping patterns; therefore, he had not had comfortable sleep for the past 5 months, and used a Philadelphia cervical collar for the previous 3 months during his sleep. He had fear of moving his neck because he had a notion of severing his spinal cord with any wrong movement. In addition, he recently had experienced difficulty in unbuttoning his clothing from time to time, which he thought was due to severe pain in his shoulder and arm.

Examination

Examination of his neck revealed severe tenderness over the region. The patient had a positive result in the shoulder abduction relief test,²⁵ foraminal compression test,²⁶ upper limb tension test (ULTT),²⁷ and cervical distraction test. Cervical compression was not performed because of increased hardship to the patient,

Fig 3. T2-weighted axial view demonstrating large cervical disk herniation.

Table 1 EMG, NCS, EP of June 8, 2006

EMG							
Muscle(s)	Nerve(s)	Root	IA ^d	PSWs ^e	(FPs) ^a	(FasP) ^b	Volition
Rt & Lt BIC	Musculocutaneous	C5, C6	N	—	—	—	Normal MUAP
Lt BRAC	Radial	C5, C6	↑	—	—	—	Normal MUAP
Lt FCR	Median	C6, C7	↑	+	+	—	Polyphasic MUAP
Lt PT	Median	C6, C7	↑	+	+	—	Polyphasic MUAP
Rt PT	Median	C6, C7	N	—	—	—	Normal MUAP
Rt & Lt FDI	Ulnar	C8, T1	N	—	—	—	Normal MUAP
Motor NCS							
	dL ^c (ms)	PL (ms)	Nerve conduction velocity (m/s)				
Rt & Lt median	4.0	7.0	58				
Rt & Lt ulnar	3.8	6.8	60				
Rt & Lt radial	3.0						
Sensory NCS							
	dL (ms)						
Rt & Lt median	3.2						
Rt & Lt ulnar	3.1						
Rt & Lt radial	2.8						
F-wave							
Nerve(s)	Site	Latency (ms)					
Rt & Lt median	Wrist to thenar	28					
Rt & Lt ulnar	Wrist to hypothenar	28					
H-reflex							
Nerve(s)	Site	Latency (ms)					
Lt median	FCR	Absent					
Rt median	FCR	14.0					

History and physical exam: radiating neck pain to left upper limb on P/E; pain on motion in neck with decreased manual muscle testing (MMT); and sensation in left C6, C7 distribution. Finding: normal NCS result with moderate neuropathic EMG in left side C6, C7 myotomes. Impression: Above electrodiagnostic findings are compatible with moderate left side C6, C7 root lesion. *EP*, Evoked potential; *IA*, insertional activity; *PSWs*, positive sharp waves; *FPs*, fibrillation potentials; *FasP*, fasciculation potential; *Rt*, right; *Lt*, left; *BIC*, biceps; *MUAP*, motor unit action potential; *BRAC*, brachioradialis; *FCR*, flexor carpi radialis; *PT*, pronator teres; *FDI*, first dorsal interosseus; *dL*, distal latency; *PL*, proximal latency.

Motor unit action potential: the compound action potential of a single motor unit whose muscle fibers lie within the recording range of an electrode.

The following measures may be specified after the recording electrode is placed in the muscle: configuration (including amplitude, duration, number of phases, polarity of each phase, number of turns, variation of shape with consecutive discharges, presence of satellite potentials, spike duration, and rise time) and recruitment characteristics (including threshold of activation, onset frequency, and recruitment frequency—allowing classification into normal, reduced, or rapid recruitment categories).

^a Fibrillation potentials: the action potential of a single muscle fiber occurring spontaneously or after movement of a needle electrode; usually fires at a constant rate.

^b Fasciculation potential: the electric activity associated with a fasciculation that has the configuration of a motor unit action potential but occurs spontaneously.

^c Distal latency: the interval between the deliveries of a stimulus to the most distal point of stimulation on a nerve and the onset of a response.

^d Insertional activity: electric activity caused by insertion or movement of a needle electrode within a muscle. Increased: (1) in denervated muscle or in muscle that is being reinnervated, (2) in nerve compression syndromes (axonotmesis, neurotmesis), and (3) in axonal neuropathies and anterior horn disease. Decreased: after prolonged denervation, when muscle fibers have been replaced by connective tissue and with fibrosis.

^e Positive sharp waves: a big action potential from after nerve damage or denervation (an electromyographic tracing associated with denervation and some types of primary muscle disease) associated with muscle denervation or myopathy; these are often found in association with fibrillation potentials, but tend to precede them in appearance after a nerve lesion.

Table 2 EMG, NCS, EP of November 13, 2006

EMG							
Muscle(s)	Nerve(s)	Root	IA	PSWs	(FPs)	(FasP)	Volition
Lt BIC	Musculocutaneous	C5, C6	N	–	–	–	Decreased interference
Lt BRAC	Radial	C5, C6	↑	+	+	–	Polyphasic MUAP
Lt ECR	Radial	C6, C7	↑	++	++	–	Polyphasic MUAP
Lt FCR	Median	C6, C7	↑	–	+	–	Polyphasic MUAP
Rt PT	Median	C6, C7	↑	–	–	–	Normal MUAP
Lt EDC	Radial	C6, C7	↑	+	–	–	Polyphasic MUAP
Lt FDI	Ulnar	C8, T1	N	–	–	–	Normal MUAP

Motor NCS			
	dL (ms)	PL (ms)	Nerve conduction velocity (m/s)
Rt & Lt median	4.0	7.0	58
Rt & Lt ulnar	3.6	6.8	60
Rt & Lt radial	3.0		

Sensory NCS	
	dL (ms)
Rt & Lt median	3.2
Rt & Lt ulnar	3.1

F-wave		
Nerve(s)	Site	Latency (ms)
Rt & Lt median	Wrist to thenar	28
Rt & Lt ulnar	Wrist to hypothenar	28

H-reflex		
Nerve(s)	Site	Latency (ms)
Lt median	FCR	Absent
Rt median	FCR	Absent

History and physical exam: radiating neck pain to left upper limb on P/E; pain on motion in neck with decreased manual muscle testing (MMT); and sensation in left C6, C7 distribution. Finding: normal NCS result with moderate neuropathic EMG in left side C6, C7 myotomes. Impression: Above electrodiagnostic findings are compatible with: moderate left side C6, C7 root lesion with signs of active axonal damages mainly involving C6 root. *ECR*, Extensor carpi radialis; *EDC*, extensor digitorum communis.

and it was thought that it would not provide any information not already known. Cervical ranges of motion (ROMs) were approximately restricted by 40%, and there was a decreased sensation in the left C6 and C7 distribution and grade 1 myelopahy.²⁸ Deep tendon reflexes were normal in both sides; there was muscle weakness (grade 4) for the flexion-extension of the left elbow and wrist.²⁹ There were moderate to severe muscle spasms of the left paravertebral cervical muscles. The patient did not indicate any history of gait disturbance, bowel or bladder complaints, erectile dysfunction, lower limb symptoms, prior history of CR, peripheral neuropathies, diabetes, rheumatologic disease, cervical or limb surgeries, or coagulopathies.

Treatment

The treatment plan was to lessen pain, recover function, and avoid recurrences.¹⁶ A cervical pillow (Therapeutica Inc, Toronto, Ontario, Canada) was prescribed as a means of diminishing cervical mobility and relieving axial loads.^{30,31} Assurance about the care and instruction on simple activity modifications to keep the head and neck in midline, to minimize stress on the cervical spine and thereby to relieve pain and to reduce root compression, were also provided. He was instructed to apply ice (covered with dish-towel) at the base of his skull and neck bilaterally for 15 minutes, followed by a 10-minute period with no application to avoid possible reactive hyperemia.³²

Because prolonged use of a cervical collar produces muscle atrophy,^{33,34} he was instructed to increase daytime removal, with continued use at night to prevent injury during sleep.³⁵ The patient was treated 18 times (within 20 visits) in a 26-week period, initiating care 3 times a week for the first 2 weeks, once a week for weeks 3 through 6, once every 2 weeks for week 7 through 14, and once every 3 weeks for weeks 15 through 26 (Fig 5).

The management approach followed Gonstead chiropractic protocols.³⁶ According to examination, history, magnetic resonance imaging, and EMG/NCS, the main findings were at C1 ASRP, C2 PLS, C5 PRS, C7 PRS, T3 PRS, and T5 PRS. Because the patient had difficulty with cervical ROM, for the first 2 treatment visits, C1 was adjusted in a seated position, whereas C7, T3, and T5 were adjusted on a knee chest table.³⁷ After chiropractic adjustments, the patient was treated with galvanic current for pain control. Eventually, C5 was added to the adjustment protocol as per periodic examinations. To strengthen neck paraspinal muscles and to avoid end point injury, a combination of isotonic exercise within a short ROM³⁸ was prescribed, which started with the sixth visit. Starting with the ninth visit, specific strength neck exercise was prescribed.³⁹ The patient was informed about possible muscle soreness after starting these specific neck exercises.⁴⁰ At each visit, proper neck posture and follow-up of the exercise schedules were emphasized. According to the patient's diary, by the ninth visit, 80% of weakness and fatigue around left shoulder had disappeared; by visit 11, 90% of pain in the neck and left shoulder was gone; at the end of visit 15 (5 months of treatment), approximately 100% of tingling at the fingers was gone and would only appear during exercises from time to time. At the final visit, the patient was sent for EMG/NCS at the same EMG/NCS center as his previous 2 EMG/NCS.

On the last visit, the EMG results were reviewed (Table 3); outcome measures were reassessed; and correct neck posture, prescribed neck exercises, and cervical pillow use were reviewed. The NDI was analyzed using SPSS version 15.0 (SPSS Inc, Chicago, IL) (Fig 6). At the final visit, there was overall an 89.6% improvement in symptoms from the baseline. The pronounced effects noticeable were pain, personal care, lifting, headache, concentration, work, and sleeping (Table 4). In addition, there was a correlation between the addition of exercises at visit numbers 7 and 11 with the changes in the NDI score (Fig 6). Furthermore, these changes strongly correlate with the third EMG/NCS result (Table 3). Looking at insertional activity, positive sharp waves, and fibrilla-

Fig 4. T2-weighted coronal view of cervical spine demonstrating block at the C5-C6, C6-C7 disk level.

tion potentials components of the first EMG/NCS (Table 1) and second EMG/NCS (Table 2), there were C6 root lesion and left C7 root lesion. There were positive changes when comparing those components between Tables 1 and 3. This case also correlates well with the study of Murphy et al⁴¹ with regard to the optimal number of treatment visits needed for patients with CR. Looking at the graph (Fig 6), the patient was stable after visit 13. The patient's final diary log indicated that some residual pressure and burning sensation in the left thumb and index finger were present for a few hours during the day and that these sensations faded away.

Discussion

Several studies support conservative, nonoperative treatment of CR with respect to functional outcome and pain reduction^{42,43}; however, improvements of symptoms seem to last for a short while.⁴⁴ However, there are others who suggest that manipulation is

contraindicated in the presence of a herniated disk.⁴⁵ Therefore, little is known about the most effective treatments of CR; many of the outcome studies on treatment are limited by retrospective designs,⁴⁶ poorly defined treatment populations,⁴⁷ or vague and poorly defined outcome measures.¹⁴

This case study suggests a potential benefit of multimodal treatment approach in a patient with chronic CR. In diagnosing CR, several provocative tests were used. Provocative tests bring forth or worsen symptoms in the affected arm and are indicative of CR. Positive shoulder abduction relief test result is indicative of CR, whereas a negative ULTT result might be used to rule CR out.⁴⁸ A recent systematic review found that a positive

shoulder abduction relief test result had a sensitivity of 92%, specificity of 95%, and positive predictive value of 96.4% in predicting a diagnosis of a soft lateral cervical disk prolapse, whereas ULTT demonstrated high sensitivity and low specificity.²⁷ High positive predictive value of positive shoulder abduction relief test result can be used to improve the yield of positive MR examination results in patients with CR.⁴⁹ As the ROM improved, the pain was also reduced.⁵⁰ Ice was used as a counterstimulation to help to relieve spasm and pain.⁵¹ Galvanic current was used to reduce pain by inhibiting nociceptor activity and reducing edema.⁵²

Exercise is one of the most frequently used modalities in rehabilitation to gain muscle strength,

Table 3 EMG, NCS, EP of July 1, 2007

EMG							
Muscle(s)	Nerve(s)	Root	IA	PSWs	(FPs)	(FasP)	Volition
Lt BIC	Musculocutaneous	C5, C6	↑	—	—	—	Polyphasic MUAP
Rt BIC	Musculocutaneous	C5, C6	N	—	—	—	Normal MUAP
Lt BRAC	Radial	C5, C6	↑	—	—	—	Polyphasic MUAP
Lt FCR	Median	C6, C7	↑	—	—	—	Decreased interference
Lt PT	Median	C6, C7	↑	—	—	—	Decreased interference
Rt & Lt FDI	Ulnar	C8, T1	N	—	—	—	Normal MUAP
Rt & Lt APB	Median	C8, T1	N	—	—	—	Normal MUAP
Motor NCS							
	dL (ms)	PL (ms)	Nerve conduction velocity (m/s)				
Rt & Lt median	3.6	7.4	58				
Rt & Lt ulnar	3.2	6.8	60				
Rt & Lt radial	4.0						
Sensory NCS							
	dL (ms)						
Rt & Lt median	3.2						
Rt & Lt ulnar	3.1						
Rt & Lt radial	2.8						
F-wave							
Nerve(s)	Site	Latency (ms)					
Rt & Lt median	Wrist to thenar	26					
Rt & Lt ulnar	Wrist to hypothenar	25					
H-reflex							
Nerve(s)	Site	Latency (ms)					
Lt median	FCR	Absent					
Rt median	FCR	Absent					

History and physical exam: neck pain with radiation to left upper limb on P/E; decreased sensation in left C6 with pain on motion in neck. Finding: normal NCS result with old neuropathic EMG limited to left side C6 myotomes. Impression: Above electrodiagnostic findings are compatible with moderate and old left side C6 lesion with signs of chronic axonal damage without active denervation. Good recovery and remodeling compared with previous studies. *APB*, Abductor pollicis brevis.

Fig 5. Treatment schedule.

flexibility, and endurance; to restore injured tissues; and to contribute to ability to sustain normal life activities.⁵³ The Philadelphia Panel⁵⁴ found good scientific evidence (level I), which showed a clinically important benefit on pain and function with supervised isometric or slow neck movement exercises. However, 3 reviews concluded that there was insufficient evidence regarding therapeutic exercises for neck pain.⁵⁵⁻⁵⁷ After the weaning period, if a patient can develop normal strength and endurance of essential muscles, the likelihood of overstressing any structure causing injury is reduced.⁵⁸ Therefore, neck stabilization exercises were introduced as a rehabilitation

program to decrease pain, maximize function, prevent further injury, and increase neck ROM. There is no benefit of using a cervical collar in CR.⁵⁹ Prolonged use of cervical collar has adverse effects such as atrophy of the paraspinal muscle, promotion of contractures, and psychological dependence.^{7,34} A well-informed patient tends to follow instructions and ultimately may contribute to improved outcomes. Therefore, in each visit, emphasis was placed on proper positioning, body mechanics, spine anatomy, and function to assist him in avoiding further irritation.

Electromyography is an extension of the clinical history and physical examination. The classic EMG

Table 4 NDI Score

Variables	Scores at the baseline ^a	Scores at the end of treatment ^a	Mean (SD)	Improved ^b	Percentage change
Pain	3	0	0.73 (1.16)	-3	100%
Personal care	2	0	0.50 (0.64)	-2	100%
Lifting	2	0	0.90 (0.74)	-2	100%
Reading	4	1	1.20 (1.15)	-3	75%
Headache	3	0	0.47 (1.00)	-3	100%
Concentration	2	0	0.40 (0.74)	-2	100%
Work	3	0	0.70 (0.90)	-3	100%
Driving	3	1	1.27 (0.80)	-2	67%
Sleeping	3	0	0.70 (0.98)	-3	100%
Recreation	4	1	1.33 (0.98)	-3	75%
Total raw NDI score	29	3	8.10 (8.30)	-26	89.65%

^a Maximum score is 5; minimum score is 0.

^b Improved = end point - baseline.

findings in cases of radiculopathy are fibrillations in the muscles supplied by the involved nerve root (myotome) while at rest and similar evidence of denervation of the ipsilateral paraspinal muscles in that area.¹⁰ Fibrillations and positive sharp waves in cervical paraspinal muscle are considered an important indicator of radiculopathy.¹⁰

Limitations

The particular result of this case study does not prove the effectiveness of this sequential multimodal conservative management. It is not possible to suggest that this protocol would be applicable to the general population or other similar cases. However, this case may provide an alternative for clinicians and their patients to consider when managing such conditions.

Fig 6. Total NDI score at visit.

Conclusion

This case showed a positive outcome following a systemic approach to the conservative management of CR using multimodal therapy along with high-velocity, low-amplitude chiropractic manipulation. Particular sets of neck strengthening exercises may have a proper place in the treatment of CR and should be further explored.

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No funding sources or conflicts of interest were reported for this study.

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