

Dorsal Scapular Nerve Entrapments in Motor Vehicle Accidents: An Applied Kinesiology Chiropractic Case Report

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Abstract: *Objective* This case reports a unique clinical finding that helps chiropractors diagnose the entrapment of the dorsal scapular nerve (DSN), which is frequently involved in motor vehicle accident (MVA) cases. The patient endured 14 months of only partly ameliorative treatment modalities (medical, pharmaceutical, physiotherapeutic, and chiropractic), while the actual cause of her neck, arm and shoulder dysfunction was never diagnosed by her care givers. The missing component for the patient involved a DSN entrapment and interscalene triangle neck muscle dysfunction, which resolved her prolonged MVA symptom picture rapidly.

Clinical Features A 52-year-old female was referred by her brother with a 14-month history of symptoms after a MVA. Her measurable orthopedic and neuromuscular deficits are described after 21 chiropractic and 6 medical visits, including a series of 4 transforaminal epidural steroid injections as treatment.

Intervention Applied kinesiology chiropractic cranial, cervical, TMJ, and muscle subluxations involving the scalene muscles were addressed. At the time of the MVA, the patient's head was turned sharply to the left. The DSN was injured by the scalene muscles as well as the herniated discs in the lower left cervical spine, and resolution of this 'double-crush injury of the spine and muscles of the spine' resolved a great deal of her MVA symptom picture. This case offers the reader a detailed chiropractic review of DSN entrapment, the diagnostic tests necessary to find this problem, and explains the swiftest way to correct this problem.

Outcomes At the end of the first week of care (her third visit), the patient stated that she had been steadily experiencing significant recovery in her pain levels, arm numbness, shoulder ache and weakness, headaches, general body strength, mood, sleep, breathing and energy. For the first time in 14 months her arms, neck, upper back, shoulders, headaches and low back pain felt great.

Indexing Terms: chiropractic; AK; Applied Kinesiology; Dorsal Scapular nerve; MVA; nerve entrapment.

Introduction

Motor Vehicle Accidents (MVA) and the Interscalene Triangle

A n entrapment of the *dorsal scapular* nerve (DSN) is described by Cuthbert, Muir, and Harry et al at the interscalene triangle. (1, 2, 3) This muscle is frequently a persisting factor in whiplash associated disorders (WAD), including long-term neck and arm pain years after a motor vehicle accident (MVA). (1, 4, 5, 6, 7) However DSN dysfunction and its influence on the muscles of the lower neck and scapular area is not often considered for mid-scapular, upper to midback pain. (8) The DSN arises from the 5th cervical nerve's anterior ramus or as the first branch of the superior trunk of the brachial plexus where it enters the interscalene triangle. ... Patients involved in MVAs often present with subtle signs and symptoms. A strong working knowledge of clinical assessment using AK protocols can greatly assist the chiropractor with management if not resolution of these presentations ...'



The DSN almost immediately pierces the *scalenus medius* muscle, running dorsally and caudally to supply the *levator scapula* and *rhomboid major* and *minor* muscles. It is purely motor, with no sensory fibres.

It should be noted that there is considerable anatomical variance of the distribution and course of the spinal nerves. Ballesteros and Ramirez found that this usual presentation was only in 17.9% of cadavers. In another 30.4% it still arose from the usual position but shared a common branching trunk with the *long thoracic nerve*. The other reported variations included C4 in 28.4% and C4 and C5 in 23.1%. (9)

The use of the MMT and AK's techniques of therapy localisation and challenge can help determine which area is dysfunctional (experiencing motor nerve inhibition) and applicable for conservative treatment. A system of testing that identifies the specific neuromuscular consequences of single or multiple spinal nerve entrapment(s) and subluxations (and whether the putative nerve involvement has been effectively treated) may prove invaluable in cases where the sensory or motor supply to an area of pain and dysfunction in the MVA patient does not 'follow the rules' in anatomical textbooks. (10)



Entrapment of this nerve by the *scalenus medius* (Figure 1) usually involves pain along the medial border of the scapula radiating into the lateral surface of the arm and forearm. The pain is a dull ache or generalised pain, characteristic of a motor nerve. If the condition is chronic, there may be atrophy of the rhomboid muscles and possibly of the levator scapula. The *levator scapula*

receives additional nerve supply from the 3rd and 4th cervical nerves. The musculature will be tender upon deep palpation, and there will be tenderness of the lower aspect of the *scalenus medius* muscle. Palpatory pressure in this area may cause increased pain in the *rhomboid* and *levator scapular* muscles, the movements they produce, and in the arm.

Manual muscle testing (MMT) gives evidence of dysfunction of this nerve when these muscles test inhibited. If there is weakness of one or both of these muscles in the clear, the muscle(s) can usually be returned to normal strength by changing the head and neck position. If the muscles are strong in the clear, changing the neck position so that it activates the *scalene* muscles will produce immediate weakness in these muscles. The most common position that puts strain on or off the *dorsal scapular* nerve in this entrapment neuropathy is head and neck lateral flexion and rotation toward the side of involvement. This was the diagnostic process used in this case, as described below.

Because of the origin of these muscles on the spinal column, this may be the cause of recurrent subluxations in the cervical or thoracic spine, or at least chronic strain in these areas. A common finding for chiropractors who do not test these muscles in patients who have DSN entrapment is the loss of vertebral corrections as soon as the patient moves around a little; but after the DSN entrapment is corrected adequately the vertebral corrections and resulting muscle dysfunctions are no longer lost.

Clinical features

Motor vehicle accident

On 31 August 2018 this patient was the unrestrained right front seat passenger, stopped at the stop light on Prairie Avenue by the Pueblo fairground entrance. Her brother was driving the vehicle. He commented, '*Lady, don't do that*'. The patient turned her head to the left to look behind and see what was happening when the vehicle she was in was rear-ended by a large sports utility vehicle. She believes it was a Ford Expedition. Her head was turned almost completely to the left at the time of impact. Immediately after the impact she states that she was dazed and had a strange feeling like she'd hit her head, but apparently that did not occur. She was taken to Parkview Hospital by ambulance. She was examined, but no x-rays were taken. She states that she was given *Valium* and something for pain, and released. Early symptoms were soreness and stiffness in the neck and low back, and pain across the shoulders, especially along the medial border of the left side of the scapula. When I asked her to show me the location of her shoulder pain, she indicated the lower cervical/upper thoracic area, radiating out about 5" (~13cm) on each side but not in the shoulder joint itself on either side.

The patient is a drug and alcohol abuse counsellor. She did not miss any work immediately after the accident, but she states that in February or March she was only able to work half a day for about a one-month period. She states that a major problem was memory. In her occupation it is necessary to fill out many forms, and she was unable to adequately do the paper work.

Review of records from Farmers Insurance Company

On 12September 2018 the patient sought treatment from her chiropractor in Colorado. She had previously seen him for chiropractic treatment, but she states she had not seen him for about two years prior to the accident.

The first chiropractor's treatment is described by the patient as spinal manipulation. She states that she was prescribed an electric muscle-stimulating unit, which she applied at home. She also applied hot and cold packs at home on the chiropractor's recommendation. Treatment started at 3x/week and was reduced. She was now being treated on an as needed basis, and she states that she has not seen the first chiropractor in the last two months.

I received no record of the initial examination other than the records that are kept on a form where five office visits are indicated per page. There is a column for date, subjective, objective/ assessment, and plan. The forms were handwritten and contain abbreviations that were mostly unclear to me. I was unable to evaluate this information from her first chiropractor.

The chiropractor's progress report of 28 November 2018 listed main complaints as neck, lower back, and numbness while sleeping. Activities that are difficult to perform are reading, computer-work, and sleeping. It was indicated that overall the most effective aspects of treatment are adjustments, *BioFreeze*, and exercises. It was indicated that there is '*improvement from 7-8 to 5-6*'. When asked to rate improvement since starting care, it is written '*90% until now, 0% improvement.*' It is also indicated that pain comes and goes. On the next evaluation improvement is rated at 50% and '*back doesn't hurt as much, I am able to move around better with less pain.*' She added 'As long as I don't overdo anything I feel better. When I do more the pain returns.' One month later the condition was rated at 5 again, with 80% improvement and the note, '*Able to stand and walk longer and better. Able to type*.'

Medical treatment of patient for pain, mood, anxiety while driving and cognitive difficulties post-MVA

A psychologist reported that the patient was seen on 2 December 2018 for psychological evaluation. The evaluation was to help separate the emotional from the cognitive difficulties that she reported as a result of her motor vehicle accident of 31 August 2018. He noted that she was in treatment with a psychological counsellor for biofeedback and relaxation training, and was responding well. The treatment had a great impact on her headaches, and also on her cognitive difficulties. In consultation it was noted that she had done well with group therapy sessions, that her memory was at least back to 80% of its normal. It was also noted that there was increased job stress that led to some increased nightmares about the MVA.

A battery of tests were administered by the psychologist. The doctor concluded '*Interview neuropsychological test results, now almost six months past onset, are not consistent with residual neurobehavioral dysfunction as a result of concussion*.' He recommends continued biofeedback and relaxation training, and he plans to follow up with counselling.

The patient reported that cervical injections by an orthopedic medical doctor provided 70% reduction of bilateral pain for 3 to 3½ months, but symptoms were now starting again. She was medically managed by doses of *Zaraflex* and *Relafen*. The orthopedist found intact sensation, and upper extremity group muscle tests were graded 5/5.

One week later the orthopedist suggested the possibility of left sacroiliac joint injection, recommended a *Theracane*, and changed her medication to *Skelaxin*. On 19 December 2018 a left *sacroiliac* injection was performed.

On 9 January 2019 a repeat left *sacroiliac joint* injection was performed, noting that with the original injection there is reported virtually 100% reduction of left-sided low back pain, and at the time of the second injection the patient still feels approximately 75% reduction. The orthopedist reports that although there was 80% relief of symptoms from the sacroiliac joint injection for five to six months, there was a gradual recurrence of symptoms. Also there is a gradual return of symptoms from the left C7 transforaminal epidural steroid injection, even though immediately following the injection there was complete resolution of her left neck, shoulder and arm pain in the recovery room. At that time the plan was to return in two weeks for repeat injection if she continued to have pain. Orthopedist now recommended *Relafen, Skelaxin*, and repeat steroid injections.

On 3 May 2019 the orthopedist performed a C6-7 interlaminar epidural steroid injection. Finally, on 13 July 2019 a C6-7 interlaminar epidural steroid injection was done under fluoroscopic guidance.

On 6 August 2019 the orthopedist reported to her first chiropractor that the patient had received another cervical steroid injection that was not significantly helpful; however, in the past, 2 or 3 injections were necessary before any benefit was noted. She was scheduled for another injection with the orthopedist, and for repeated injections to the sacroiliac. Orthopedist notes that if she does not respond to the cervical epidural injections, surgical opinion will be recommended.

Imaging for patient after MVA (x-ray series, and 2 MRIs)

A chiropractic radiologist reported on lumbar, thoracic and cervical x-rays taken 12 September 2018. In the cervical spine there was degenerative disc disease at the C4-5 and C5-6 levels. He noted aberrant posturing and dysfunctional biomechanics often related to paraspinal muscle spasm and splinting of muscles in the thoracic spine. He noted mid-thoracic degenerative disc disease accompanied by mid and lower thoracic anterolateral *spondylosis deformans*. He also noted, *'Bibasilar subsegmental discoid atelectasis versus linear interstitial fibrotic scarring, more pronounced on the left.'* For the lumbar spine he noted mild and moderate degenerative diseases accompanied by anterolateral *spondylosis deformans*. There was early degenerative arthrosis of the sacroiliac joints. There was a right renal calculus overlaying the renal pelvis. He also noted aberrant posturing of an anterior shift accompanied by pelvic unleveling, which was low on the left. There is also a thoracolumbar laevorotatory curvature.

A medical MRI ordered for the cervical spine on 4 October 2018 noted chronic disc degeneration and disc space narrowing, and bulging of the annulus fibrosis at C6-7. There was also disc protrusion on the left with encroachment on the lateral recess and possible impingement of the left C7 nerve root. Radiologist also noted minor disc bulging at C5-6 and C4-5.

A second MRI of the cervical spine 5 August 2019. C6-7 moderate degenerative changes of the disc space with disc bulge/herniation, causing neural canal stenosis and lateral recess effacement, more on the left than right with associated mild cord compression. The neural foramina *'are patent. There is no evidence of foraminal nerve root impingement.'* At C5-6 there were mild to moderate degenerative changes with a posterior desiccated disc bulge and osteophyte formation, more on the right than left, causing lateral recess effacement without evidence of nerve root impingement of cord compression. At C4-5 there were mild degenerative changes of the disc space with posterior osteophyte formation, causing ventral subarachnoid space effacement without evidence of cord compression or displacement. Also noted was straightening of the cervical curvatures, *'suggesting muscle spasm'*.

Professional Applied Kinesiology (PAK) Chiropractic Examination

The patient was first seen by the author on 20 October 2019. She stated that her condition improved under the first chiropractor's treatment, but then eventually plateaued around January, 2019. She states that the injection treatments by two orthopedists helped her significantly. She states that she saw a neurologist only one time and had a CT scan or MRI done of her head; she is not certain which. She states that the treatment by the psychologist was helpful for her to cope with and regain memory ability as needed in her profession. She also states that the biofeedback treatment that was helpful.

In the process of preparing this report I was concerned about the arm numbness that the patient was still experiencing. During the examination I noted a positive Wright's test and costoclavicular syndrome. I felt it necessary to do some additional tests that were not done in her previous examinations and treatments, and the patient agreed. Medical pathologies were ruled out, and the patient returned for AK examination and treatment on 28 October 2019.

Symptoms on presentation

Patient stated that she had daily headaches, primarily in the occipital region. She got relief by taking *Tylenol* and *Alka-Seltzer*. She stated that she frequently had numbness in her arms. She had pain in her neck and between her shoulders. Her shoulders feel weak, and she has trouble holding anything above her shoulders for very long. She felt more eyestrain than she used to.

She had some difficulty in swallowing. She had an aching sensation frequently in the left arm. She had mid-thoracic pain. She stated that her low back hurts when she walks, and her knees ached when walking. She had general aching in her legs.

Her sleeping ability was worse since the accident, and she has low energy. She had a history of temporomandibular joint dysfunction that was no different since the accident. She stated that she was in good health prior to the accident. She had previous medical care that included gallbladder surgery about 2015 and a hysterectomy in 2011. She also had an appendectomy in 1990. During my systems review she denied any other health care problems.

Cervical range of motion measured by Cybex compound inclinometer:

Flexion = 40°	Extension = 55°
Left Lateral flexion = 35°	Right Lateral flexion = 46°
Left Rotation = 68°	RightRotation = 65° (measured supine)
Height 66" (167.6cm), weight 262 lbs (118.4kg). Blood pressure 140/90 sitting, 136/88 standing.	

Standing posture showed slight right head elevation, head position slightly forward, and right shoulder elevation. AP curves are within normal limits except for the forward head position.

Orthopedic tests

(Persisting despite 14 months of WAD treatment)

Romberg, finger-to-finger, finger-to-nose and heel-to-shin tests are passed. The left heel-to-shin test is passed with difficulty.

Left shoulder depression test caused discomfort in the cervical spine and some radiation down the left arm. Right shoulder depression caused discomfort in the cervical spine but no radiation into the arm. Left Jackson foramina compression test caused discomfort in her neck with pain radiation to her head; no radiation to the arm. Right Jackson foramina compression test caused the same head pain and neck pain with no radiation to the arm. Travell's *Scalene relief test* was positive on the left. These are not commonly taught in chiropractic colleges and are pictured here.

Travell also offers several physical examination tests which the author has found useful. The Scalene-relief test (Figures 2, 3,) helps to identify whether the scalene muscle possesses a MTrP or other dysfunction as a source of referred pain that is caused or aggravated by clavicular pressure on the nerves passing over the elevated first rib or the involved muscle.

In the test, the examiner's fingers demonstrate the tightness of the space between the clavicle and scalene muscles. The fingers then demonstrate the increased clearance behind the clavicle when the patient raises their shoulder and arm. Clearance beneath the clavicle is maximized by swinging the shoulder forward, which pivots the clavicle forward and upward to fully relieve clavicular pressure on the thoracic outlet structures. Pain relief by this test occurs immediately or in a short period of time.

The second test demonstrates a physical finding in the fingers when there are MTrPs in the scalene muscles (Fig 4). The patient attempts finger flexion and the test is normal when the

fingertips can firmly touch the palm of the metacarpophalangeal joints. When there are MTrPs in the scalene muscles, all four fingertips may fail to touch the metacarpophalangeal joints. Simons and Travell observe that 'the referred motor effects of MTrPs frequently are independent of, and can affect different locations than, referred sensory effects. Apparently, MTrPs in the scalene muscles similarly inhibit finger flexors when the MCP joints are extended.' (11)





Fig 4: Finger-flexion Test indicating Scalene Muscle MTrP involvement

Adson's and Allen's tests were negative. Wright's tests were positive. Costoclavicular tests were positive bilaterally.

JayMar hand dynamometer tests were right = 55/55/60 lbs; left JayMar = 65/60/60 lbs. She is right hand dominant.

Bechterew and Lindner's seated tests were negative. FABERE Patrick test bilaterally caused discomfort in the left sacroiliac. Straight leg raise test was limited at about 45° by tight hamstring muscles. The straight leg raise did not cause any radiating pain. *Sartorius* muscles were strong bilaterally.

Mennell's sign was positive at the left sacroiliac, negative on the right. Hamstrings and *gluteus maximus* were strong bilaterally. Prone hip extension did not cause pain in the sacroiliac joints, nor did Ely's test. Hibb's test was negative.



Trendelenburg tests were negative bilaterally. Kemp tests were negative bilaterally. Forward bending was adequate, about 8" (20.3cm) fingers to floor. Lateral range of motion bilaterally was within normal ranges. Extension was within normal range.

The patient filled out a pain drawing, Neck Disability Form, Oswestry Low Back Disability Form, and fifteen questions on a Visual Analog Scale of Neck and Associated Pain at my request.

The pain drawing was marked in the areas that she described during consultation. The codes for symptoms are contained within the drawing, and appropriately there are no exaggerating comments marked on the form. There was an explanation on the form that the 'N' for Numbness is at night mainly, and the 'A' & 'B' for Ache and Burning are all the time.

The Neck Disability Form is a modification of the Oswestry Low Back Disability Form to apply to the cervical spine and associated pain. Her score was 22, placing her in the moderate bracket of

neck disability. This correlates with my impression of her following consultation and examination.

The Visual Analog Scale of Neck and Associated Pain had a total score of 1900. The questions are 0-100 on a grid of 0-10. Of the 15 questions there are 19 scales of 1-10, giving the total score of 1900 (some questions are bilateral). Patient's score was 820.

Her score on the Oswestry Low Back Disability Form was 23, placing her in the moderate bracket of low back disability.

The Visual Analog Scale of Low Back Pain has a total score of 1500. The questions are 0-100 on a grid of 0-10. The patient's score was 1160.

PAK Manual Muscle Tests (MMT) Rationale

The purpose of specific muscle tests in this examination is to determine if there is objective evidence to substantiate the continuing subjective complaints. If so, then the examination design continues to determine the cause of the dysfunction and whether it can be improved. To accomplish this, various sensory receptor stimuli are applied to determine if the muscle dysfunction is improved, indicating the weakness is functional in nature and has potential for improvement. If there is improved muscle function, the type of sensory stimulus that causes the improvement separates the problem from a peripheral neuropathy, receptor, spinal cord, brainstem, cerebellum, thalamus, or cortical lesion. Unless otherwise noted the muscle tests listed in this examination as strong are equivalent to 5 and weak as 4 as graded in the *Guides to the Evaluation of Permanent Impairment*, 7th edition by the American Medical Association.

Clinical findings

Biceps, triceps and *brachioradialis* reflexes were 1+ bilaterally. Upper extremity sensory function was intact. Bilateral *deltoid, serratus anterior, infraspinatus, supraspinatus, subscapularis* and *teres minor* muscles were all strong. *Rhomboid* muscles were weak bilaterally and strengthened with the cervical spine in slight flexion and rotation to the side being tested. *Pectoralis* muscles (*clavicular* and *sternal* divisions) are strong bilaterally. Deep neck flexors muscles test strong; but the left *anterior scalene* and *sternocleidomastoid* muscles test weak bilaterally.

There was a positive AK '*ocular lock*' test. There is a saccade of eye movement in the right upper quadrant. When the eyes are held in that quadrant there was general muscle weakness. This is a vital finding in patients with persisting symptoms after MVAs. (1)

The examination found disorganisation between cranial nerves III, IV, and VI producing the saccade of eye movement and weakening of previously strong muscles when the eyes were held in that direction. This is due to failure of good organisation between the head-on-neck, visual righting, and labyrinthine reflexes. Abnormal afferent input from the vestibular, visual, or somatosensory systems are common in MVA patients, and can result in abnormal sensory-motor control. The resulting mismatch, which may occur in the presence of conflicting afferent information, may underlie symptoms of dizziness or unsteadiness, problems in maintaining a stable upright posture, and measurable deficits in head and eye movement control in people with headache and neck pain after a MVA. (1, 12, 13, 14)

Pectoralis minor muscles tested weak bilaterally and strengthened with origin-insertion (OI) technique. With the *pectoralis minor* muscles strong they were further tested after stretching and they re-weakened. The *sternal division* of the *pectoralis major* muscle was also positive to the muscle stretch reaction, i.e., the muscle weakens after being stretched. The *subclavius* muscles tested weak bilaterally.

Abdominal muscles tested strong. *Psoas* and *tensor fascia lata* muscles test strong bilaterally. *Extensor hallucis, tibialis anterior, tibialis posterior,* and *peroneus* muscles test strong bilaterally. Long head of the *rectus femoris* strong bilaterally.

Pelvic category I was positive on the right, with the cervical extensors being inhibited on the right as well. There is associated pain at the right cervicothoracic junction. Pressure on the right *sacrotuberous* and *sacrospinous* ligaments eliminates the pain at the cervicothoracic junction.15 Pelvic category II test is positive.

Professional Applied Kinesiology Chiropractic Treatment

This patient continued to have dysfunction as a result of the motor vehicle accident of 31 August 2018 despite epidural steroid injections, chiropractic, and psychological counselling.

There were three areas identified in my AK examination that were treated to bring her to a higher level of function.

There was subtle nerve entrapment of the DSN bilaterally. The evidence for this was the weak *rhomboid* muscles that strengthened when the cervical spine was slightly flexed and rotated to the side of rhomboid test. The DSN traverses through the *scalene* muscles. If they are hypertonic they impinge on the DSN, causing *rhomboid* muscle weakness. The head and neck position of flexion and rotation takes tension off the *scalene* muscles, restoring strength to the *rhomboid* muscles.

Fig 5: Left rhomboid MMT



Left rhomboid muscle weak in the clear: Strengthens with slight flexion and lateral rotation of neck to left side

Further indication of this disturbance was the weakening of the *infraspinatus* muscle when the shoulder was placed in protraction. The *infraspinatus* muscle is supplied by the *suprascapular* nerve that traverses the *suprascapular foramen* on its way to the *infraspinatus* muscle. When the ipsilateral *rhomboid* muscle is weak the scapula moves too far forward with shoulder protraction, stretching the *suprascapular* nerve and the previously strong infraspinatus muscle weakens. This is a superior form of patient-education regarding peripheral nerve entrapments, because the patient both sees and feels the dysfunction occurring as the AK challenge procedure is employed.

When a nerve entrapment is close to the spine, such as in some types of thoracic outlet syndrome, many muscles in the extremity may be weak because the entire neurovascular bundle

may be involved. Still, challenge and therapy localisation as used in AK helped locate the specific area of involvement in the lower cervical spine and scalene muscle group. When the correct approach was found for this more central entrapment, many muscles in her extremity strengthened and eliminated the numbness in her left arm permanently.

Direct treatment was applied to the *scalene* muscles over the course of two visits in the form of fascial release by massage and percussion. The doctor's fingers found the dysfunctional part of the scalene triangle, and a *Fulford percussor* was used through the back of the doctor's hand to mobilise the *scalene* muscle's injuries. This strengthened her *rhomboid* muscles, and they were re-tested after two and then four days to determine that the correction was lasting.

Commonly found with this pattern of dysfunction is an anterior subluxation of the 5th, 6th, or 7th cervical vertebra. This was corrected as well, and improved her left arm numbness and pain, as well as removed weakening of her rhomboids and levator scapulae muscles following neck rotation. This anterior cervical subluxation was very likely related to the cervical disc herniations seen on her MRIs, and alleviated her arm pain of 14 months after the first week of treatment.

The cervical extensors were also inhibited, causing tension in the *scalene* muscles, due to lack of opposition from the extensor muscles, and these were corrected with a category I and II pelvic adjustment. The pelvic category I is torsion of the pelvis that is often associated with a compensatory torsion of the shoulder girdle. This was supported in this patient's case by the relief of the right cervicothoracic pain by my digital pressure applied to the *sacrotuberous* and *sacrospinous* ligaments. This is a spondylogenic referred pain from the pelvis to the cervical and upper thoracic area. (15)

The *sternocleidomastoid* muscles also tested weak bilaterally. They are supplied by Cranial Nerve XI. I explained the muscle weakness to the patient and I performed a therapeutic trial (called *'cranial challenge'* in AK) to determine if the muscle could be returned to proper function. I examined to determine the proper vector of correction and applied a gentle left inspiration and right expiration assist cranial correction to the mastoid processes bilaterally. The effort was successful with an immediate return of strength to the sternocleidomastoid muscles. On her third visit I re-tested the sternocleidomastoid muscles that were strengthened during my first examination, and they still tested strong.

It appeared that the patient's arm numbness was from costoclavicular neurovascular compression, and also from *pectoralis minor* neurovascular compression. There are several factors that were contributing to this. The *pectoralis minor* and *pectoralis major* (*sternal division*) showed the AK '*positive muscle stretch reaction*' indicating hypertonicity of the muscles. This was treated by a fascial release similar to Rolfing the muscle, as well as percussion via the *Fulford* percussion device. There also were trigger points in the muscles that were treated, removing the '*positive muscle stretch reaction*'.

The continuum

There is a continuum between the multiple items treated in this case. Correction of the DSN entrapment changed the scapular movement during shoulder motion, in turn affecting the shoulder girdle. Correcting the *sternocleidomastoid* muscle function changed the dynamics of

cervical motion, affecting both cervical subluxations and fixations. Pelvic correction affected the entire shoulder girdle complex. In the first week of treatment it was necessary to continue examination as treatment was administered. What was apparent during the initial comprehensive examination may be different at the next examination and was definitely changed as treatment was administered.

As noted the treatment must be adequate to immediately produce objective evidence of improved motor nerve function, i.e., *rhomboid* muscles immediately strengthen, *infraspinatus* muscle maintains strength with shoulder protraction, normal pulse on Wright's and *costoclavicular* tests, and the elimination of the several findings of muscle stretch reaction.

After 2 weeks of PAK treatment all cervical range of motion was improved, as were her visual analog scales (going from 820 on initial examination to 80 after 2 weeks of treatment), and the Neck Disability Form and Oswestry Low Back Disability Forms, each going from the '*moderate disability*' (or 22) rating to '*no disability*' rating (or 6).

Discussion

Dorsal Scapular Nerve Entrapment in the Interscalene Triangle A Unique AK Chiropractic Approach

Dorsal scapular nerve entrapment was first reported in applied kinesiology in 1981. (16) Since then advances in applied kinesiology have shown increasing integration of this entrapment with other conditions such as the anterior cervical subluxation (hidden cervical disc) and suprascapular nerve entrapment.

Familiarity with the course of every testable muscle's nerve supply and possible locations of entrapment enables the physician to evaluate various muscles supplied by the nerve above and below the possible area of lesion. Muir offered a comprehensive review of the DSN in the etiopathology of many other similar diagnoses, including cervicogenic *dorsalgia* (CD), *notalgia paresthetica* (NP), SICK scapula and a posterolateral arm pain pattern. SICK scapula is the acronym for the condition Scapular malposition, Inferior medial border prominence, Coracoid pain and malposition, and dysKinesis of scapular movement. (17) Muir describes this entrapment as a '*little known cause of upper back pain*' in the profession. (2) *Dorsal scapular* nerve entrapment is a little known, but emerging, cause of post-MVA back and arm and shoulder pain and dysfunction.

The DSN arises predominately from the 5th cervical nerve and may receive contribution from C4 and C6. The nerve is purely motor, with no sensory fibers. It enters the interscalene triangle and almost immediately pierces the *scalenus medius* muscle, running dorsally and caudally to supply the *rhomboid major* and *minor* muscles and a portion of the *levator scapula*. The *middle scalene* is normally innervated by branches from the anterior rami of the third through eighth cervical spinal nerves. The *levator scapula* receives additional nerve supply from the 3rd and 4th cervical nerves. Anatomically, the DSN provides the direct link from the mid to lower cervical spine to the mid-scapular region.

Symptoms (1, 2, 8)

Entrapment of this nerve by the *scalenus medius* muscle usually involves pain along the medial border of the scapula, radiating into the lateral surface of the arm and forearm. The pain is a generalised dull ache, characteristic of a motor nerve.

There may be no historical event the patient can recall for the cause of this pain, but usually there is trauma or occupational ætiology. The most common is trauma to the *scalene* muscles by violent stretching such as cervical hyperextension-hyperflexion of whiplash dynamics.

Occupations that require extended overhead work, such as painters and electricians, make workers susceptible to develop DSN entrapment. In this case the patient's symptoms developed after her MVA and were exacerbated by her work positions.

Pain in the scapular region is not necessarily related to stimulation of the intervertebral disc or surrounding tissue nerve receptors. Entrapment of the DSN can cause pain and dysfunction of the *levator scapula* and *rhomboid* muscles. Trigger points may also cause referred pain into these areas.

If the condition is chronic, there may be atrophy of the rhomboid muscles and possibly of the levator scapula. Since the *rhomboid* muscles contribute to holding the scapula against the posterior thoracic cage, one may see a winging of the vertebral border away from the thorax and a separation from the spinous processes. This will be exaggerated by arm abduction. The scapular winging is much more subtle than that of winging due to *serratus anterior* weakness. (8, 16)

The patient's posture is usually in a head forward position. There may be some lateral flexion and rotation of the neck that relax the scalene muscles, taking pressure off the DSN. This is similar to the antalgic position in intervertebral disc conditions.

In addition to the general aching the patient complains of, the rhomboid and levator scapula muscles are usually tender with deep palpation. There will be tenderness of the lower aspect of the *scalenus medius* muscle. Palpatory pressure at this area may cause increased pain in the *rhomboid* and *levator scapula* muscles, and in the arm.

The *rhomboid* and/or *levator scapula* muscles may or may not test weak in the clear. If there is weakness in the clear the muscle(s) can usually be returned to normal strength by changing the head and neck position. The most common position that takes strain off the DSN is head and neck lateral flexion and rotation toward the side of involvement. The position may need to be changed a little between tests to find the exact position that strengthens the muscle(s). Take care that the patient is not contracting the scalene muscles in this position, causing additional compression on the nerve.

Unilateral entrapment of the DSN causes an imbalance between the bilateral rhomboid major and minor muscles and/or of the bilateral levator scapulae muscles. Because of the muscles' origin on the spinal column, an imbalance of forces on the spine may result in subluxations in the cervical or thoracic spine, or at least chronic strain in those areas. In the absence of muscle correction one may correct a subluxation in this area only to have it recur as soon as the patient becomes active. After the DSN entrapment is corrected and the muscles return to normal, the vertebral corrections will be maintained.



Scalene Muscle Review and its Manual Muscle Test

Fig 6: Scalene muscles

Scalenus Anticus

Attachments: From the anterior tubercles of the transverse processes of the 2nd-6th cervical vertebrae to the scalene tubercle on superior surface of the 1st rib.

Action: flexes and rotates cervicals; raises 1st rib.

Nerve supply: anterior branches, C5, 6, 7, 8.

Scalenus Medius

Attachments: From the posterior tubercles of the transverse processes of 2nd-7th cervical vertebrae to the superior surface of the 1st rib behind subclavian groove.

Action: flexes and rotates cervical vertebrae; raises 1st rib.

Nerve supply: posterior branches of anterior primary rami of C3, 4; lateral muscular branches of C3, 4.

Scalenus Posticus

Attachments: From the posterior tubercles of transverse processes of 4th, 5th, and 6th cervicals to the lateral surface of 2nd rib posterior to the attachment of serratus anticus.

Action: flexes and rotates cervical vertebrae; raises 2nd rib. Note: All scalenes, when acting bilaterally. flex the neck.

Nerve supply: posterior branches of C5-8; lateral muscular branches of C3, 4.



Testing method

Fig 8: AK points





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Postural Imbalances

Loss of normal lordosis in the cervical spine may be observed on x-ray, especially due to weakness of the scalene muscle group. This is frequently present after whiplash injuries. In hyperextension injuries, the scalene muscles may be severely stretched and some of the fibres torn.

In an acute case, it is characteristic for the patient to support her head and neck with her hands. With these more severe injuries, the ligaments are sprained and the muscles may be lacerated, with accompanying haemorrhage and oedema. There may be damage to the sympathetic nerve fibres that lie on the *longus colli* muscle, causing unusual symptoms such as nausea, dizziness, blurred vision, and possibly unilateral dilated pupils (Horner's syndrome). Earache and even precordial pain may develop. (18)

Lateral neck tilt is present from unilateral weakness of the scalene group.



Alternate Testing Methods

These muscles may be tested in a seated or standing position. The clinician must carefully stabilise the trunk and observe for any attempt by the patient to alter the parameters of the test. The easiest weight-bearing test is obtained by leaning the patient against an upright examination table. Free nerve endings are scattered throughout the skin and are grouped around the bases of hair. They can register pain and pressure. (19) Gentle contacts on the patient's head are essential for accurate MMT of these muscles in this position.

Special Notes on the scalenes

Muscle injuries of the scalene muscles frequently results from hyperextension during whiplash dynamics. If the head is turned during the MVA or the patient is hit from the side, the injury will be more unilateral.

Falla, Jull and Hodges (20) found that the deep neck flexors in particular have reduced EMG activity in patients with neck pain. The importance of diagnosing this physical finding in patients with neck pain makes the MMT all the more important. It is likely that the reason patients with chronic neck pain have difficulty maintaining cervical lordosis is this weakness in the deep neck flexor muscles.

When the sinuses are involved, the muscular weakness is often due to lymphatic involvement. The neurolymphatic reflexes may require considerable manipulation to clear the involvement. (21)

The *scalene* muscles are accessory muscles of respiration. When the head and neck are stabilised, the *scalene* muscles elevate the first rib; the *posterior scalene* elevates the second rib, thereby lifting the entire rib cage. They are active during quiet respiration, and highly active during forced inspiration. It is generally considered that the scalenes anchor the 1st rib during quiet breathing, while the external intercostals elevate the remaining ribs toward the 1st. In general, the scalenes are more important as a secondary muscle of respiration than the SCM.

Active myofascial trigger points in the scalenes refer pain and paraesthesia symptoms into the ipsilateral *deltoid* area, over the *biceps* and *triceps*, and along the radial side of the forearm, thumb, and index finger.

Occasionally the muscles of the cervical region, including the scalene group, are primarily involved. More commonly the local area causing compression is secondary to some other involvement, such as a category 1 pelvic problem, foot problem, etc. (23)



Fig 10. From Travell & Simons: Anterior scalene trigger point pain referral patterns

Conclusion

There are numerous orthopedic provocative tests that are used in evaluating peripheral nerve entrapment in the upper body. Most of these can be used in conjunction with manual muscle testing. In this case, the DSN was involved.

A previously strong rhomboid muscle tested weak with full neck rotation (identical to the position the patient was in at the time of the MVA), indicating entrapment of the DSN by the scalene muscle(s).

Conversely, when the rhomboid muscle tested weak, positions that relaxed the scalene muscles or otherwise changed the position of the thoracic outlet caused the rhomboid to become strong, providing evidence of entrapment at the lower cervical spine and interscalene triangle.

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Cite: Cuthbert S. Dorsal Scapular Nerve Entrapments in Motor Vehicle Accidents: An Applied Kinesiology Chiropractic Case Report. Asia-Pac Chiropr J. 2022;2.6. URL apcj.net/papers-issue-2-6/#CuthbertDorsalScapular

About the author

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As this Case Report demonstrates Dr Cuthbert practices chiropractic with Mastery of the AK approach.

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