REMARKABLE RECOVERIES

Non-Operative Treatment of Cervical Radiculopathy

A Three Part Article from the Approach of a Physiatrist, Chiropractor, and Physical Therapist

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ABSTRACT

The painful condition resulting from soft tissue damage and degenerative disc changes causing pressure on a cervical nerve root is called cervical radiculopathy. It often produces agonizing neck pain, a burning sensation, along with numbness radiating down the arms, shoulder blades, and back, or up into the head. Authors discuss cervical radiculopathy from the position of a Physiatrist (R.H.), chiropractor (G.B.), and physical therapist (C.F.). Each author reviews case studies and techniques utilized in order to successfully treat patients presenting with cervical radiculopathy.

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KEYWORDS: Barré-Lieou syndrome, cervical lordosis, cervical radiculopathy, McKenzie exercises, physical therapy, Prolotherapy, RESULTS system.

Cervical radiculopathy refers to a pinching or inflammation of a cervical nerve at its exit point in the spine, called the neuroforamen. It is caused by lesions that narrow the space in the neuroforamen, including cervical disk herniations, but more commonly occurs with cervical spondylosis.[1,2] This latter condition refers to a gradual wear and tear or age-related degenerative changes.[3] Many of these changes can be diagnosed or identified on conventional X-rays and MRI's and may include narrowing of the disc space, bulging of the contour of the disc, herniation of the disc, calcification of the disc, and vertebral margins that result in spurs. (*See Figure 1.*) When the spurring significantly narrows around the nerve root exit passage or foramen it is referred to as neuroforaminal stenosis. These degenerative changes can lead to constant or episodic waves of pain. The symptoms of cervical radiculopathy typically include severe neck pain with radiation of the pain to the back of shoulder blade, shoulders, arm, or hand. Numbness or weakness in the arm can also be present.

Cervical radiculopathy is a neurologic condition characterized by dysfunction of a certain spinal nerve, the roots of the nerve, or both. Cervical radiculopathy usually presents with pain in the neck or one arm, with a combination of sensory loss, loss of motor function, or reflex changes in the affected nerve-root distribution.[4] Cervical radiculopathy can also cause headaches,[5] head pain,[6] and facial pain or dysfunction. Population-based data from Rochester, Minnesota, indicates that cervical radiculopathy has an annual incidence rate of 107.3 per 100,000 for men and 63.5 per 100,000 for women, with a peak at 50 to 54 years of age.[7] The most common cause of cervical radiculopathy (70 to 75 percent of cases) is from foraminal encroachment of the spinal nerves due to a combination of factors, including decreased disc height and degenerative changes of the uncovertebral joints anteriorly and zygapophyseal joints posteriorly. Disc herniation of the nucleus pulposus is responsible for 20 to 25 percent of cases.[8] Cervical radiculopathy can be multifactorial in etiology, with onset also initiated from zygapophyseal (facet) joint syndrome, ligament laxity or injury, tumors, infections, inflammatory mediators, and/or trauma.

ANATOMY AND PHYSIOLOGY

The anatomy of the cervical spine consists of seven cervical vertebra, six cervical discs, eight pairs of cervical nerve roots, ligaments, muscles, and the spinal cord. Eight pairs of cervical nerve roots are formed directly from multiple tiny rootlets that originate directly from

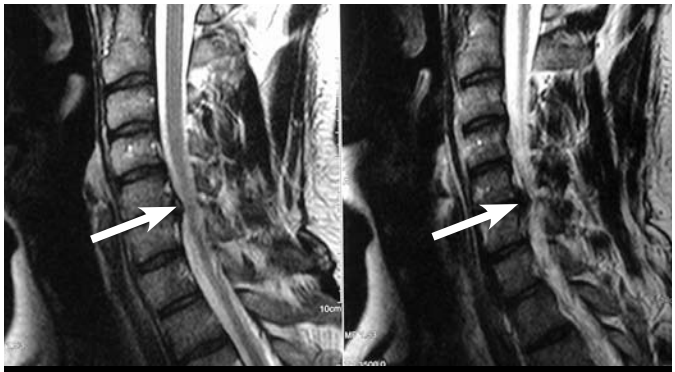

Figure 1. MRI of patient with cervical radiculopathy showing degeneration in cervical spine.

the spinal cord. These tiny rootlets coalesce immediately within the intraspinal canal and form the dorsal (sensory) and the ventral (motor) roots. These join together just before passing through the intervertebral foramen and form the spinal nerve root. On exiting the foramen, the nerve root splits into the small posterior ramus and the larger anterior ramus. In contrast to the roots, there are only seven cervical vertebra whereas the eight root exits below the seventh cervical vertebra and above the first thoracic vertebra.[9] It is as the cervical nerve roots enter the neuroforamina that they are most susceptible to injury. The neuroforamen are bordered anteromedially by the uncovertebral joint, posterolaterally by the facet joint, superiorly by the pedicle of the vertebral body immediately above, and inferiorly by the pedicle of the vertebral body immediately below. The medial section of the foramen is derived from the intervertebral discs and the vertebral endplates. The roots originate in close proximity to the level at which they exit the intraspinal canal. Consequently, the cervical roots generally pass through the canal and in a somewhat more horizontal fashion. This arrangement causes the neuroforamen to originate more medially and the cervical root and the cervical spinal cord to be in close proximity, thereby susceptible to abnormalities of these medial structures such as osteophytes or disc herniations, leading to the symptoms of cervical radiculopathy.[10,11]

A majority of patients who have cervical radiculopathy improve within 1-2 months with appropriate medical treatment, which can consist of rest, cervical immobilization, analgesics, anti-inflammatory agents, muscle relaxants, physical therapy, as well as chiropractic or osteopathic manipulation.[12-14] There are several case series reports suggesting that even patients with severe neurological deficits and severe pain can be managed quite successfully using a nonoperative approach.[15-17] Generally the patient is to refrain from repetitive movements of the neck and forceful or heavy lifting. Sometimes a soft cervical collar is prescribed to limit neck motion and provide splinting and rest in a position of comfort. Physicians will often prescribe anti-inflammatory medications or short courses of oral corticosteroid medications to provide pain relief and hopefully decrease nerve inflammation. Physical therapy is used to provide techniques such as intermittent traction and McKenzie exercises to try and decrease nerve tension by opening up the neural foraminal spaces. Chiropractors may utilize mobilization techniques such as manipulation when vertebral rotations are involved in the disease process. For those who do not respond to these conservative measures or for those whose pain is excruciating, cervical epidural steroid, periradicular steroid, or Prolotherapy injections may be given. For some, surgery will be recommended. This article will look at a variety of conservative nonoperative approaches including Prolotherapy, chiropractic, and physical therapy available to patients who are suffering from cervical radiculopathy. Some patients will need just one of these techniques, but others require some or all of the therapies to resolve their cervical radiculopathy. ■

A Chiropractic Therapeutic Approach to Cervical Radiculopathy

Glen M. Batson, DC

CHIROPRACTIC CERVICAL SPINE EVALUATION

The chiropractic approach to the evaluation and treatment of cervical radiculopathy is similar to the allopathic approach and diagnosis, however, the chiropractic evaluation centers on the spinal segments, their contiguous biomechanical function, and alteration of segmental biomechanical function which may cause associated neurological and soft tissue symptomatology. The chiropractic analysis reviews the symptomatology, however, further investigates to determine the primary mechanism of action causing the associated symptomatology. The doctor of chiropractic is trained to evaluate the patient as a whole. The point of pain is reviewed as is all integrated biomechanics and system functions. The point of pain is a symptom, and not always the direct point of pathology. The premise of the chiropractic philosophy is that the vertebral subluxation, whether caused through direct trauma or micro trauma, causes altered vertebral segmental function, causing joint instability, and thus a myriad of sequential events. The vertebral segmental dysfunction, subluxation, causes irritation to the facet joints and disc material via abnormal function, stretching of the supporting ligament structure, altered biomechanical function, irritation to neuro receptors, abnormal loading of facets and disc material with subsequent disc bulge or herniation, and thus neurological compromise. The subluxation complex not only causes

altered joint function, but also biochemical changes at the joint level also facilitating in the degenerative process due to the direct insult or origin of this subluxation. The chiropractic examination encompasses a review of posture, gait, scoliosis, shoulder heights, and foot/ankle function. The chiropractic treatment for this condition is to correct and stabilize the subluxation process through spinal manipulation, soft tissue stabilization and re-education through strengthening and conditioning, education of ergonomics and posture, and nutrition.

In the chiropractic field of medicine, spinal manipulation is utilized for the therapeutic correction of a subluxation. Spinal manipulation is delivered in many forms, however in this office, a spinal manipulation is defined as a predetermined specific degree of force delivered to a specific spinal segment by a trained chiropractic physician, in a specific direction, for a specific end result: the correction and restoration of the joint structure, and relief of associated soft tissue and neurological compromise. A chiropractic adjustment should be a therapeutic thrust or percussion to an osseous structure for correction of the joint instability, correction of biomechanical function, restoration of osseous and ligament function and integrity, for relief of the associated soft tissue and neurological compromise. The chiropractic adjustment should be delivered manually by the physician's hand or a percussive machine, however, segmental specificity, degree of thrust or percussion, and direction of thrust is integral in the proper restoration of spinal function.

I utilize the "RESULTS" system of chiropractic analysis and procedures formulated by Dr. Walter V. Pierce.[1] The RESULTS system of chiropractic is exactly as it is read; results are the ultimate goal. The RESULTS technique for chiropractic analysis utilizes multiple diagnostic modalities for interpretation of the subluxation and neurological compromise, and a therapeutic treatment regiment for the restoration and correction of these structural and neurological conditions. The RESULTS system utilizes static X-ray examination of the spinal regions in question for evaluation of pathological process, subluxation complex, degenerative joint and disc disease, disc space thinning, osteophytic formation, and determination of postural integrity.

Static X-rays are performed for determination of the subluxation and for determination of the cervical lordosis. The cervical lordosis should be a curve apexed anterior with a 17cm anterior convexity. The normal lordosis is integral to the cervical biomechanical functioning. Loss of the normal lordosis, to any degree less than normal lordosis, indicates altered facet function, increased axial load to the intervertebral disc, and increased stress to the surrounding ligament structures. The loss of lordosis also indicates some degree of anterior head translation and ultimately compensatory loading throughout the lower lumbar spine and pelvis. (*See Figures 1a & 1b.*)

Fluoroscopic spinal X-ray imaging is also utilized and consists of dynamic imaging of the spinal regions in question for real-time imaging of the osseous structures in full ranges of motion for proper and specific diagnosis of facet function, ligament laxity, disc integrity, and pathological process.[2-14] Fluoroscopic analysis is the only diagnostic procedure to visibly evaluate the spinal segments in normal motion for determination of biomechanical function or pathology. All other imaging such as X-ray, MRI, CT are in a static mode, non-motion, possibly not demonstrating a segmental instability or pathology. All imaging is recorded on a DVD recorder for analysis and storage for comparison studies if needed. All radiographs and fluoroscopy scans are performed in the standing, weight bearing position. DTG instrumentation is utilized consisting of infrared diagnostic heat sensing of the dermatomal levels of the spinal regions for determination of vascular and neurological compromise. The readings are graphed and retained for comparison analysis.

I utilize a Variable Frequency Adjuster instrument for applying induced harmonic forces to spinal segments and other articular complexes. Resonant oscillations, when induced within a vertebral complex by a driven harmonic frequency have shown to improve range of motion, and muscle relaxation resulting from the reprogramming or re-education of mechanoreceptors within the articular complexes of the vertebral segments.[15] Mechanoreceptors respond to continual changes in the loading and unloading of spinal articular complexes.[16] This procedure is utilized by performing percussive activity to the posterior segments of a selected vertebra for restoration of joint and ligament function, restoration of cervical lordosis, and an increase in normal posture. This procedure can be performed in the prone or seated position. (*See Figure 2.*)

Deep tissue neuro-musculoskeletal re-education therapy is rendered to patients, as indicated, for the restoration of cervical function, reduction of spasm, increase in cervical range of motion, retraction of the cranial, cervical,

Figure 1. Comparison of before and after X-rays show improvement in cervical lordosis, as indicated by Georges Line which runs along posterior vertebral bodies.

and scapula region to increase the cervical lordosis and posture. A portable cervical Starr Traction appliance is utilized in conjunction to the manipulation for traction of the disc and osseous structures of the cervical spine to rehydrate the disc, educate ligaments and muscles, and to relieve the neurological irritation. Home ice therapy regiments are utilized for the reduction of edema, spasm, and pain.

RESULTS System normal X-ray line analysis findings: Cervical lordosis of 17cm, superior C1 angle of 18 to 24 degrees, zygapophysis angle at C5 or C6 of 35 to 55 degrees, C2 angle of 0.0 degrees, A-P vector intersection of 0.0. Fluid and contiguous function of facet, ligaments, and endplates via fluoroscopic analysis. (*See Figure 3*.)

CLINICAL CASE STUDY

Case # 4842: The patient is a 54 year-old female who experienced severe cervical spine pain and severe right upper extremity pain, numbness, and tingling resulting from lifting objects in her home. Patient has been diagnosed by primary physician and emergency room physicians as cervical radiculopathy. Medication was rendered consisting of Vicodin with mild relief. Patient presented to Batson Chiropractic with complaints of cervical spine pain, pain into the upper bilateral shoulder and scapular region with pain radiating to the right shoulder, right upper extremity region 8/10 in severity. Patient described numbness, tingling, and pain throughout the entire right upper extremity region extending into the hand and fingers consisting of the first, second, and third digits. Patient describes cervical crepitus, pain in all ranges of motion, muscle spasm and tension into the shoulders bilaterally, loss of strength of the right upper extremity region as well as pain into the right shoulder and scapula region.

Physical Examination: reveals a 54 year-old female, presenting with pain to the cervical spine and right upper extremity. Patient presents with positive orthopedic and neurological findings consistent with the diagnosis of cervical radiculopathy.

Figure 2. Patient being treated with Variable Frequency adjuster.

X-ray Examination: consisted of static A-P, Lateral, Flexion, Extension views of the cervical spine revealing loss of cervical lordosis with mild kyphosis of the lower cervical region measuring 34 cm, gross anterior head translation measuring 45 mm as measured from the anterior superior endplate of C7 to a perpendicular plum line from the anterior aspect of the C1 tubercle, C5 zygapophysis angle of 37 degrees, C2 angle of -30 degrees, and C1 angle of 22 degrees, degenerative joint and disc disease with disc space thinning C5-C6 with large osteophytic formation

Figure 3. X-ray of cervical spine demonstrating normal lordosis.

and vacuum phenomenon, milder vertebral and disc degeneration at the C4-C5, and C6-C7 segmental levels with mild osteophytic formation. Facet sclerosis noted at multiple levels. Flexion-extension views of the cervical region revealed subluxation: C0 in flexion, C1 flexion, C2 flexion, C6 flexion, C3 extension, C4 extension, C5 extension, C6 extension.

MRI examination: revealed mild atlantodental joint degeneration, minimal posterior disc bulge at C3-C4 right of midline, mild circumferential disc annual bulge C4-C5 with mild impression upon the thecal sac without evidence of spinal cord impingement or neuroforaminal or canal stenosis. C5-C6 revealed degeneration of the intervertebral disc with circumferential annular bulging approximately 3.5 mm posteriorly. There was effacement of the CSF space and slight flattening of the surface of the cord by the bulging disc annulus without evidence of cord compression. Moderate bilateral neuroforaminal narrowing due to the bulging of the intervertebral disc and adjacent posterolateral uncovertebral joint osteophytes. There was impingement of the C6 nerve root bilaterally. C6-C7 disc degeneration with eccentric right posterolateral annual bulging of approximately 2 mm. Moderate to marked right neuroforaminal narrowing due to the posterolateral soft disc protrusion with possible impingement of the right C7 nerve root and foramen.

Patient received twenty therapeutic chiropractic treatment sessions as outlined above and twelve cervical traction sessions over a nine week period of time. Patient responded to chiropractic procedures with positive outcome, experiencing complete resolution of all subjective symptomatology, normal findings of all objective findings, marked improvements in post radiographic findings. Patient returned to normal daily living status with mild restrictions.

Post static lateral radiographic findings after nine weeks of care demonstrated improvements in line analysis as: C1 angle 16 degrees (prior 22 degrees), C2 angle -17 degrees (prior -30 degrees), C5 zygapophysis angle 34 degrees (prior 37 degrees), lordosis angle -58 degrees (prior -34 degrees), measurement of anterior head translation of 16 mm (prior 45 mm).

Conclusion: Patient responded to chiropractic spinal care with complete resolution of cervical radiculopathy, and all subjective symptomatology. Resolution and restoration of proper objective findings are demonstrated by examination and post radiographic findings. Continued care was recommended for further structural spinal restoration.

CONCLUSION

Neck pain is encountered frequently and is considered one of the most common chronic pain conditions and a major problem in modern society.[17] Pain associated with the cervical spine can be multi-factorial in etiology. Cervical radiculopathy is one set of conditions that is associated with the complications as related to the underlying mechanism of neck pain. Poterfield and DeRosa[18] refers to the cycle wherein **pain** causes **spasm** which causes **decreased blood flow** and **edema** which causes **hypoxia** and **biochemical change** causing **chemical irritation** resulting in **pain.** There is substantial evidence that the chiropractic adjustments are beneficial in relieving a wide variety of pain syndromes. As discussed, the philosophy of chiropractic is that the primary mechanism of the condition is the vertebral subluxation causing the altered segmental function, instability, and the cascade of neurological and biomechanical ramifications as outlined above. The combination of the restoration of the segmental dysfunction/subluxation, ligament function and integrity, disc height and function, and postural changes all benefit the patient and their specific presenting symptomatology. A large number of case reports and documentation have appeared in peer-reviewed and literature supporting chiropractic treatment and chiropractic manual therapy.[19-23] As evidenced throughout, the multi-factorial condition

of cervical radiculopathy may indicate a multidiscipline approach for therapeutic correction and recovery. The combination of chiropractic manipulation, Prolotherapy, physical therapy, traction, postural and ergonomic education all may play an integral role in the alleviation of the neurological compromise associated with cervical radiculopathy.

As a doctor of chiropractic, I am a proponent of preventative medicine. Understanding the sequella of complications which can cause ailments or serious health ramifications, Chiropractic analysis and treatment in conjunction to Prolotherapy, strengthening, and postural correction are essential for the well being of the population, young or old. The prevention, or even the correction, of a vertebral subluxation can have far reaching positive ramifications in our daily lives. Trauma or injury to the spinal regions causes splinting. Splinting causes prolonged fixations between segments which further decreases the overall range of motion in the neck and imposes unnecessary additional stress on damaged intersegmental units that are trying to heal. By reducing the adjacent fixations through manipulation, we restore more normal biomechanics to the spine, and in turn relieve the stress at the injured segments, thereby providing an environment more conductive to repair.[24] Correction of the subluxation reduces and eliminates the cycle of pain as outlined by Poterfield and DeRosa. Education of the population, both the public and health care providers, on spinal biomechanics and essentials of maintaining or correcting spinal biomechanics is imperative in the quest for preventative and optimal health. ■

Therapeutic Injections for Cervical Radiculopathy

Ross A. Hauser, MD, Physiatrist

Even when faced with severe disabling pain, many patients desire a non-surgical approach to their problem. While anti-inflammatory medications and oral corticosteroids can decrease nerve inflammation, some cases of cervical radiculopathy necessitate injecting steroids directly into or around the inflamed nerve. Studies have shown that even patients who have not responded to physical therapy, oral medications, and other conservative treatments, or those whose cervical radiculopathy symptoms and radiographic findings make them surgical candidates, can still experience significant benefits with cervical epidural and periradicular steroid injections and not need surgical intervention.[1,2] An Orthopedic Surgery Task Force on Neck Pain that appraised the scientific literature from 1980 to 2006 on surgical interventions for neck pain alone or with radicular pain concluded, "it is not clear from the evidence that long-term outcomes improved with the surgical treatment of cervical radiculopathy compared to nonoperative measures."[3] The Cervical Spine Research Society did a prospective, multicenter investigation of patients who presented with symptomatic cervical radiculopathy from cervical spondylosis and/or disc disease. They found that 26% of patients who underwent surgery reported persistent excruciating or horrible pain on follow-up.[4] For these reasons, a nonoperative conservative approach, which may include cervical injections, is prudent for most patients with cervical radiculopathy.

Cervical radiculopathy is, by definition, a disease of the cervical spinal root in which the nerve root is either impinged upon, inflamed or both.[5] Steroid and/or Prolotherapy injection therapy is utilized to help the patient (1) maintain an ambulatory or outpatient treatment status; (2) maintain participation in a physical therapy or rehabilitation program; (3) continue to work (4) decrease the need for analgesics; and (5) in some cases, avoid or delay surgical intervention.[6,7]

Steroid injection therapy for cervical radiculopathy is utilized to directly decrease the inflammation in a specific nerve root. Each cervical nerve can be injected (or blocked) paravertebrally by approaching the nerve in a lateral or posterior direction. Cervical nerve roots (C1-C8) pass laterally through their respective foramina with the sulcus of each transverse process and exit at the level above the vertebral segment for which they are numbered (*See Figure 1.*) Since these transforaminal or periradicular corticosteroid injections are given onto a specific nerve root, they are typically done under fluoroscopic guidance. Studies have shown statistically significant neck and radicular pain relief with these types of injections.[8,9]

When it is not clear which cervical nerve root is involved or if several nerve roots are irritated, a cervical epidural injection can be utilized. The procedure can be performed in an outpatient setting using fluoroscopy (X-ray guidance) where a needle can be directed, in most cases under local anesthesia alone, to the target site.

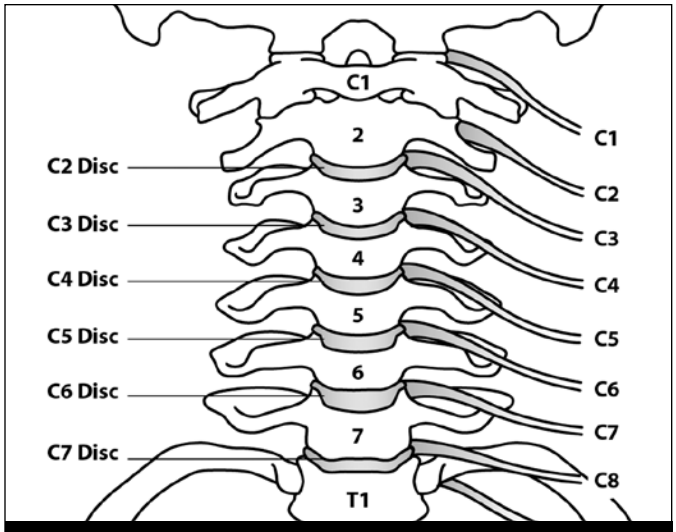

Figure 1. Anterior view of neck showing cervical nerve roots. Cervical radiculopathy occurs when one of these nerve roots is irritated or pinched.

(*See Figures 2a & 2b.*) The membrane covering the spine and nerve roots is called the dura. The space surrounding the dura is the epidural space. An epidural injection places anti-inflammatory medicine into the epidural space to decrease inflammation of the nerve roots, reducing pain and hopefully aiding the healing process. It may provide permanent relief or pain relief for several months while the injury/cause is healing. Improvement may occur immediately or within two weeks. Some patients will respond with one injection, but some may require up to three, interspersed over the course of a recovery period of one to three months. It is still unclear which factors or conditions, including herniated discs or spinal canal stenosis, optimize pain relief with cervical epidural steroid injections.[10,11]

One of the most useful techniques in experienced hands for the treatment of cervical radiculopathy is Prolotherapy. Prolotherapy has a long history of being used in neck pain with and without arm and hand pain.[12-17] The mechanisms by which Prolotherapy can decrease pain and expedite healing time can be seen in *Figure 3*. Since many people with neck pain with concomitant shoulder, arm or hand pain come with the diagnosis of cervical radiculopathy, the first order of business for the treating physician is to investigate whether or not the diagnoses are correct. What most doctors and patients don't realize is that ligament injuries in the neck can refer pain down the arm. (*See Figure 4.*) In my experience the most common reason for referral pain or pins-and-needles sensation

Figure 2a. C7 nerve root block under fluoroscopy. While the patient is in a supine position with the neck turned to contra-lateral side, a 25 gauge 2 inch needle is advanced under fluoroscopy into the right C6/7 neural foramen.

Figure 2b. C7 nerve root block under fluoroscopy. After confirmation of accurate needle placement with flow of contrast along the right C7 nerve root in both the AP and oblique views, injection of a local anesthetic and steroid is performed.

Prolotherapy can decrease pain and expedite healing time by producing:

- Decrease in Muscle Spasms
- Stabilization of Vertebral Segments
- Stimulation of Ligament Growth
- Elimination of Referral Pain Patterns
- Resolution of Multiple Pain Generators
- Improvement of Spinal Alignment

Figure 3. Mechanisms by which Prolotherapy can decrease pain and expedite healing time.

down the arm is not a pinched nerve, but ligament laxity in the neck or upper thoracic region. Clearly if someone does not have a somatic (voluntary) nerve getting pinched (one of the cervical nerves discussed above) then having the person get a transforaminal or cervical epidural steroid injection(s) would be futile. If such a person had cervical ligament injury as the cause of their neck pain

Hackett Referral Patterns

HEAD AND NECK REFERRAL PAIN PATTERNS
LIGAMENT AND TENDON RELAXATION

AREA OF WEAKNESS	REFERRAL PATTERN
OCCIPUT AREA A	FOREHEAD AND EYE
OCCIPUT AREA B	TEMPLE, EYEBROW, AND NOSE
OCCIPUT AREA C	ABOVE THE EAR
CERVICAL VERTEBRAE 1-3 (UPPER)	BACK OF NECK AND POSTERIOR SCAPULAR REGION (NOT SHOWN)
CERVICAL VERTEBRAE 4-5 (MIDDLE)	LATERAL ARM AND FOREARM INTO THE THUMB, INDEX AND MIDDLE FINGER
CERVICAL VERTEBRAE 6-7 (LOWER)	MEDIAL ARM AND FOREARM INTO THE LATERAL HAND, RING AND LITTLE FINGER

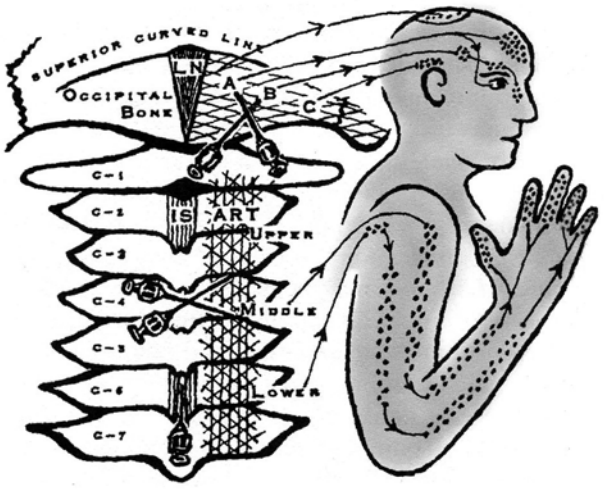

Figure 4. Ligament injuries to the neck can refer pain to the arm and hand as depicted in this referral diagram outlined by Dr. Hackett.

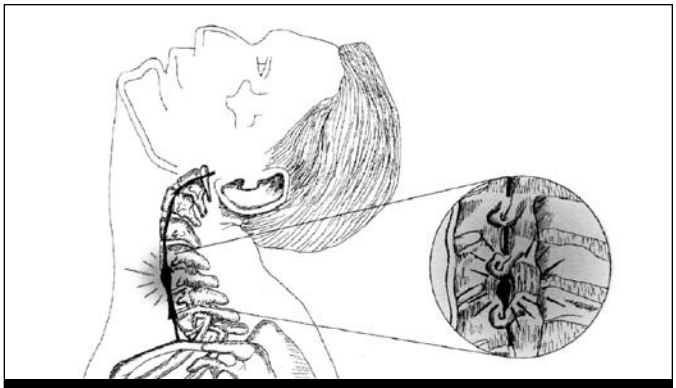

Figure 5. Whiplash injury in sports can lead to Barré-Lieou syndrome. Injury to the ligaments in the neck can cause the vertebrae to move (subluxation) pinching on the autonomic sympathetic nerves.

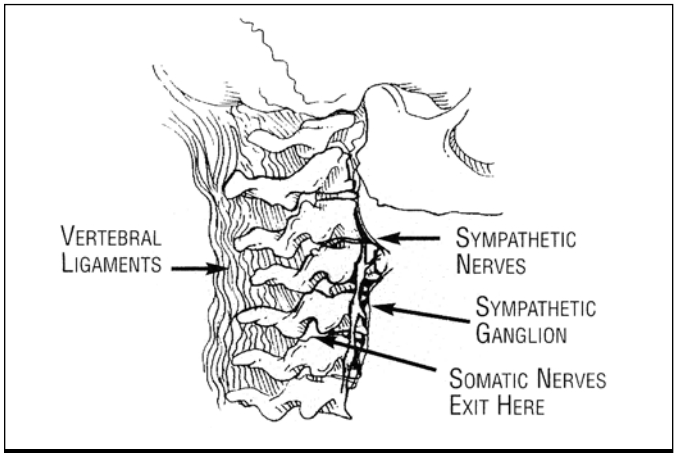

Figure 6. Relationship of the sympathetic nerves to the neck vertebrae. The sympathetic nerves and ganglion sit just in front of the cervical vertabrae, and their proper functioning depends on proper vertebral alignment.

Symptoms that Characterize Barré-Lieou syndrome

- Headache
- Facial pain
- Ear pain
- Vertigo
- Tinnitus
- Loss of voice
- Hoarseness
- Neck Pain
- Severe fatigue
- Sinus congestion
- Chest pain
- Sense of eyeball being pulled out
- Brain fog

Figure 7. Symptoms that characterize Barré-Lieou syndrome.

with referral symptoms down the arm then Prolotherapy or other conservative treatments would be warranted.

Ligaments are taut structures that prevent excessive movement of bones. The cervical ligaments prevent excessive movement of the neck vertebrae. When these cervical vertebrae rotate excessively to one side the condition is called cervical subluxation. This excessive movement of cervical vertebrae can lead to the irritation of autonomic nerves (nerves not under our voluntary control) which can lead to a host of symptoms including Barré-Lieou syndrome. (*See Figures 5, 6, & 7.*) Whether a person has had a forceful whiplash injury or side flexion injury, or they simply just sit at a computer terminal with forward head posture, ligament laxity or injury can result. (*See Figure 8.*)

If the ligament weakness condition persists, not only can cervical subluxation occur, but the body will induce muscle spasm and eventually bone overgrowth or spur formation to stabilize the unstable segments. Dr. Liyand Dai from Changzheng Hospital in Shanghai, China found a direct correlation between cervical instability and the development of disc degeneration (arthritis of the neck).[18] Prolotherapy has been found to be effective for the

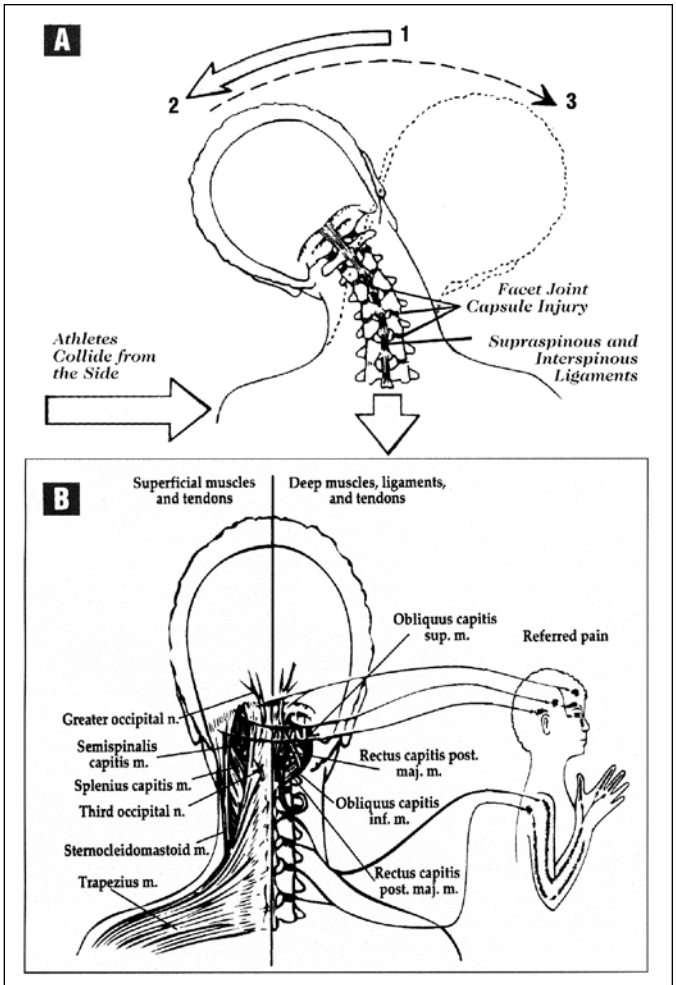

Figure 8. A forceful side flexion injury results in asymmetric injury to the facet joints, vertebrae, and associated ligaments. Pain can then develop in the head and arm because of the referral patterns of the neck ligaments.

treatment of cervical instability.[19] Prolotherapy will treat the underlying cause of the person's cervical instability or cervical degeneration by stimulating ligament repair. It can be used alone or in combination with the treatments discussed in this article. The following is a case history to show how Prolotherapy was used in the treatment of cervical radiculopathy.

CASE STUDY #1. CERVICAL RADICULOPATHY IMPROVES WITH PROLOTHERAPY

A 38 year-old male, came to see Dr. Ross Hauser at Caring Medical in April 2008 with complaints of severe pain in his neck that radiated down his right arm with numbness of his right index finger and posterior wrist (C6 distribution). His pain began earlier that month after lifting a TV. Prior to this injury he was an active person who did not have pain. He stated that his pain was at its worst when lying down (a 10 out of 10 pain), but is helped by wearing a neck brace while sleeping. He was taking Norco two to three times per day for pain, a Medrol dose pack, and Daypro at the time of his first visit. An MRI ordered by his primary doctor revealed a right sided disc herniation at C5-C6 and C6-C7.

Upon initial exam, his right arm muscle strength was normal but had slightly diminished sensation in C6 dermatome. Upon extension of his neck and right lateral rotation he had shooting pains down his right arm. The patient received Prolotherapy at his first visit to his entire neck and right scapular region. He was taken off Norco and Daypro and given Ultram for pain and Ambien to help him sleep.

He returned every 2 weeks for the same treatment and at his 3rd visit he reported 50% improvement in pain. His pain was down to 5 out of 10. He still had numbness of his right index finger with lying down. He moved his appointments to every 3 to 4 weeks over the next few treatments and at his 5th visit he reported 70% improvement in pain and that he no longer had pain unless he was lying down. His finger was unchanged at this time.

The patient continued his Prolotherapy every 6 weeks or so over the next few treatments and, at what would have been treatment #9, he reported that his neck was doing "really good." He did not receive treatment at this visit to his neck but wanted to get his knees and feet treated for unrelated injuries because Prolotherapy had worked so well on his neck. He was on no pain medication for his cervical radiculopathy after his 8th visit and the sensation to his right index finger and posterior wrist was back to normal. He was also back to full activities including exercise. Six months after his last Prolotherapy treatment he continues to do well.

CASE STUDY #2. THE DOCTOR'S CASE

While the last case study was treated with only Prolotherapy and medications, there are times where a variety of therapies are needed to resolve cervical radiculopathy. The following case I know very well because it is my own (R.H.). In January 2008, I had the best race of my life when I ran a 1:29:53 and placed 82nd out of over 12,000 people in the Disney Half Marathon. I made the podium for my age group (45 to 49). The next day I paced my

wife, Marion, to a 5:11 marathon. Within a few weeks after this I noticed a severe pain by my right scapula after a swim workout. I was unable to do my planned workouts over the next few days as the pain grew worse. Eventually it was completely disabling, causing me to keep my neck flexed and often my right arm raised with my palm on the back of my head to provide relief. The pain was severe on the right side of my neck, right scapula and felt like a hot poker digging into the right back of my hand between my thumb and index finger. The pain was making work very difficult, and despite pain medication, the pain continued.

I eventually had an MRI and X-rays of my neck. The MRI showed no surgical lesions, but did show extension degeneration bilaterally especially at the C5-C6 region. (*See Figure 9.*) The neck radiograph showed a straight cervical spine with loss of cervical lordosis and a posterior, right, superior C6 vertebra. (*See Figure 10.*) Trying to choose the most conservative treatment, chiropractic, physiotherapy, including high velocity manipulation, and some physical therapy (including analysis by C.F.) was done. After several weeks and a 50% reduction of the pain, a video fluoroscopic analysis was done (by G.B.). This still showed a posterior right C6, but the alignment and motion of the upper cervical spine was improved. G.B. then started treating me with the Pierce Technique of chiropractic. This had me to 85% improvement, but after a bike accident (yes, I was still training), I regressed back to severe neck, scapular, and arm pain. At this point a series of Prolotherapy treatments were started using stronger solutions in the left lower cervical region to help with spinal alignment. The first Prolotherapy alone produced definite improvement. Within a couple of weeks after the first Prolotherapy treatment I was back on my bike and exercising almost daily. By early April, I was back to Ironman training.

In total, I needed four Prolotherapy visits but I am happy to say that in July 2008, I completed the Ironman in Lake Placid, despite it pouring rain the whole time. After swimming 2.4 miles and cycling 112 miles in the pouring rain I was still able to run a 4 hour 20 minute marathon. (*See Figure 11.*) It is now over 18 months after my cervical radiculopathy incident and I am completely pain free though on occasion I will get a very, very slight tingling in the back of right hand. My friends know that I am back to running, cycling and swimming with a vengeance. As there are many others out there who need to know that cervical radiculopathy can be treated conservatively, we decided to write this article for *JOP*! ■

Figure 9. MRI of Ross Hauser showing extensive degeneration at C5-C6. This overgrowth of bone was one of the causes of my cervical radiculopathy.

Figure 10. Lateral C-spine X-ray. The curved line shows the normal curve of the cervical spine. This X-ray demonstrates a straight cervical spine, indicative of a lot of muscle spasms which commonly occur with cervical radiculopathy.

Figure 11. Ross Hauser, MD during the 2008 Ironman Lake Placid. A 4:20 marathon in the pouring rain after swimming 2.4 miles and cycling 112 miles in a downpour is pretty good for a 45 year-old who just a few months prior to this had full blown cervical radiculopathy.

Physical Therapy Approach to Cervical Radiculopathy

Chris Ferrigno, MS, PT

Cervical radiculopathy can be a severely debilitating condition which can be difficult to manage for both the patient and the health care provider. While a far less common malady than lumbar radiculopathy, cervical radiculopathy is widespread and a very common diagnosis treated within a physical therapy practice. Physical therapists have many treatment options focusing on treating both the symptoms and the underlying origin of the condition.

Historically, physical therapists have been trained to use physical modalities to provide a short term decrease of patient's symptoms. These modalities often include thermal agents such as hot packs, cold packs, or other physical agents like ultrasound, electrical stimulation, interferential current and iontophoresis, for pain control. I certainly see the benefit of using physical agents for pain control, especially with a patient who is experiencing acute, severe discomfort. However, there has recently been a shift in the approach many therapists take, including myself, to treat cervical radiculopathy. The focus for cervical radiculopathy is now centered more on the cause of symptoms rather than simply addressing symptoms themselves.

In 1932, Joel Goldthwait et al. wrote a marvelous description of posture and body mechanics relating to health and disease.[1] His writings were specific to the health of children, but his lessons were revolutionary, profound and very applicable to the approach that many physical therapists now take in treating cervical radiculopathy.[1] Goldthwait wrote, "Body mechanics may be defined as the mechanical correlation of various systems of the body with special reference to the skeletal, muscular and visceral systems and their neurological associations. Normal body mechanics may be said to obtain when this mechanical correlation is most favorable to the function of these systems."[1] In other words, deviate from the norm and problems will occur. Many cases of cervical radiculopathy are discogenic,[2] and occur because of an accumulation of mictotrauma to the cervical spine. To understand the physical therapist's approach to treating the cause of cervical radiculopathy, I would like to review discogenic pathology and discuss its relationship with posture and biomechanical deviations.

Discogenic pain results from either a bulge of a lower cervical disc in the posterior or posterolateral direction, migration of a disc or fragment, or from a herniation of the nucleus pulposis protruding through the annulus. The disc, while a highly stable structure, also has its breaking point, which is a crucial concept in understanding the progression of neck pain and cervical radiculopathy. In the case of the cervical spine, proper alignment is required for the optimal cervical disc environment. When improper forces are applied over a period of time, the disc degrades. In the case of poor posture, the most common postural deviation is the forward head posture.[3] (*See Figure 1.*) This posture, which has been directly correlated to neck disability[4] and pain,[5] applies increased forces to the anterior aspects of each lower cervical disc and decreased forces to the posterior aspect of the disc, thereby creating a pressure differential. This differential in pressure, when repeatedly applied over decades of life, can cause the nucleus of the disc to migrate posteriorly,[6] leading to the aforementioned bulge or herniation posteriorly.

Cervical radiculopathy and neck pain cases have been on the rise in my practice over the last few years. A quick anecdote might explain the reason for this increase:

As I was on an airplane a few months back, I was sitting slumped, staring at the mini screen of my MP3 player,

Figure 1. Forward head posture and slouching can be directly responsible for a person's neck pain.

and realized I was having a slight numbness in my thumb. I lifted my head, looked around the plane, and counted 34 passengers who were looking down at cell phones, MP3 players, and the countless other techie devices existing today, reading newspapers, and playing Soduku. (*See Figure 2.*) I envisioned the 34 poorly-postured passengers going to work the next day for 8-10 hours, logging on to the computer while placing a phone between an ear and shoulder, until they could return from work maybe via a train, like I do, where they would continue their barrage of texting, emailing, and song selection with their hand held devices, only to arrive home where they would spend the remainder of the evening on the sofa in front of the TV, laptop in hand, staring at the screen with forward head and shoulders, wondering who be the next person voted off the island or which couple lost the most weight, while updating their social network site and cleaning all the viruses off of their hard drive. Basically, many of these people would be spending 16+ hours of their day with a slumped, forward head posture, compressing both their lower cervical disc and opening up their neural foramen allowing spurs to form.

Yes, I know this was a bit of an exaggerated response, but I thought about my thumb numbness, and the pains and parasthesias of my patients, and realized that my approach to neck pain, which focuses on posture and mechanical treatment, was validated even more during the quick glance around the plane. I can give patients hot packs, home e-stim units, neck stretch exercises, mobilizations, and soft tissue massages, but unless the stimulus of their disorder was addressed, their condition was not going to be corrected in the long term.

Figure 2. Poor posture throughout the day can cause many issues including cervical radiculopathy.

Clinicians can address patient's posture and biomechanical deviations in a variety of ways. In order to promote improved alignment in all spinal segments, I start with instructing patients on proper pelvic positioning moving up through the lumbar and thoracic spine. I teach patients which surfaces are good for sitting, including firmer surfaces and chairs which fit their body geometry. I discuss how to properly position themselves in the appropriate chair as well as how to position themselves within their workstations, whether at home or at the job. (*See Figure 3.*) I then look at various ways to enhance scapular stabilization, which will provide a solid base for the cervical spine. This is achieved by having patients work the stabilizing muscles such as serratus anterior, middle and lower trapezius, rhomboids, and latissimus dorsi. After the patient has a comprehensive understanding of how to effectively contract these muscles, then additional exercises are issued to combine scapular stabilization with cervical retraction with everyday arm movements, such as reaching overhead, carrying their briefcase, or simulating typing at their desk.

After the lumbar, thoracic, and scapular positions have been addressed, the cervical spine is managed through the use of a mechanical approach involving cervical retraction. This movement, if performed properly, will decrease lower cervical spine flexion and upper cervical extension, both of which occur in forward head positioning. As lower cervical flexion decreases, the pressure on the anterior aspect of the lower cervical disc decreases. This results in even disc pressure—the best environment for the disc.

While cervical retraction is an exercise to progress and promote proper posture, it also can be used as both a palliative and therapeutic exercise to directly and immediately address the patient's pain. An important concept of cervical retraction is taking the movement to the end range of that movement. (*See Figure 4.*) The exercise may be done in sitting, supine or even prone, depending on the patient's response during a thorough evaluation. End range movement is crucial to initiate pain centralization. By retracting the cervical spine, pressure is place on the posterior aspect of the cervical disc. With repeated movements at end range, the disc has the potential to creep anteriorly and take pressure off the irritated nerve.[7,8] Cervical retraction exercises can also be coupled with cervical extension at some point during the treatment so as to provide increased force from

Figure 3. Patients are taught appropriate posture and positioning while sitting.

Figure 4. Cervical retraction taken to the end-range of the movement.

posterior to anterior on the cervical spine. (*See Figure 5.*) The upper thoracic and upper cervical spine would also be addressed, to reduce the stresses in the affected lower cervical spine. With significant repetition and progression of force on the disc (using all of the mentioned methods), centralization of symptoms can occur,[9] resting cervical posture can improve,[9] and the chance of reoccurrence of symptoms can be reduced.[8,10,11]

CASE STUDY #1

A 52 year-old, female attorney came in with complaints of right arm pain, which was medically diagnosed from the referring physician as cervical radiculopathy. This patient reported a 50% reduction of symptoms from cervical ESI (epidural steroid injection). She presented with C6 dermatomal pain, with intermittently severe symptoms. Following a mechanical evaluation, which initially exacerbated her symptoms, the patient was instructed on cervical retraction exercises to perform every two hours during waking hours. The patient returned one week later for follow up with slight pain in the upper arm and neck only. The patient was reinstructed on the retraction exercise, and in the clinic the patient was able to abolish her radicular symptoms and had moderate axial pain. During that visit, the retraction movement was changed slightly in order to emphasize a higher degree of end-range movement. On second follow-up, another week later, the patient reported no significant pain with an occasional axial aching pain.

CASE STUDY #2

A 48 year-old, male restaurateur presented to physical therapy with significant, nearly constant right upper trap and right lower humeral pain, and intermittent pain into his right thumb. The patient could easily turn on and off his thumb pain when sitting at work by simply changing the chair at his desk, and found significant relief sleeping in a foldable beach lounger. During mechanical evaluation, the patient's symptoms were exacerbated with end-range cervical retraction. By the end of evaluation, the patient could tolerate a movement approximately 25% of his end-range movement. The patient required a total of six visits, required various posture changes, including changing the position in which the patient performed his exercises, from supine, to prone, to sitting.

In summary, the treatment of cervical radiculopathy requires considerable attention to the patient's posture and body mechanics. Clinicians need to make the patient aware that they can manage their condition with a few basic movement principles which include a well-performed cervical retraction coupled with cervical extension motion. (*See Figure 6.*) While not all patients respond to mechanical treatment, which usually includes cervical retraction, cervical and thoracic extension, and posture education, most patients are successful in significantly reducing their peripheral and central symptoms. ■

Figure 5. Cervical retraction coupled with cervical extension.

Figure 6. A well-performed cervical self-retraction.

CONCLUSION

Cervical radiculopathy, though a serious and disabling painful condition, can often be treated conservatively. At times, Prolotherapy, nerve blocks, chiropractic, osteopathy or physical therapy alone can resolve the condition, sometimes a combination of approaches will be needed. While the person is getting treated, close monitoring by the clinicians is necessary to ensure the condition is resolving. With proper care non-operative treatment of cervical radiculopathy is not only effective but recommended, in these authors' clinical experience. ■

* In a future JOP article we will also present the osteopathic approach to cervical radiculopathy.

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