A Clinical Model for the Diagnosis and Management of Patients with Cervical Spine Syndromes

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Abstract

Background:

Disorders of the cervical spine are common and often disabling. The etiology of these disorders is often multifactorial and a comprehensive approach to both diagnosis and management is essential to successful resolution.

Objective:

This article provides an overview of a clinical model of the diagnosis and management of patients with disorders related to the cervical spine. This model is based in part on the scientific literature, clinical experience, and communication with other practitioners over the course of the past 20 years.

Discussion:

The clinical model presented here involves taking a systematic approach to diagnosis, and management. The diagnostic process is one that asks three essential questions. The answers to these questions then guides the management process, allowing the physician to apply specific methods that address the many factors that can be involved in each individual patient. This clinical model allows the physician to individualize the management strategy while utilizing principles that can be applied to all patients. At times, the management strategy must be multidisciplinary, and cooperation with other physicians and therapists is often necessary for effective patient care.

This model is currently being used by the author in practice, as well as forming the basis upon which further research can be conducted to refine or, if necessary, abandon any of its aspects, as the evidence dictates.

It is the purpose of this paper to present this clinical model and the clinical and scientific evidence, or lack thereof, of its components.

Key Words

Cervical spine, chiropractic, conservative management, neck pain, headache, rehabilitation.

Introduction

Neck pain and related disorders are a group of conditions that are common and often disabling. It can be argued that the importance of these disorders is under-appreciated. Because of the prevalence of low back pain and its great cost to society, much clinical attention and research dollars are focused on the low back. But epidemiological research suggests that cervical related disorders are as common and may be more costly to society than low back disorders[1-4].

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Fifty to seventy percent of adults will experience neck pain some time in their lives[1]. Bovim, et al[2] found that at any given time, 1/3 of people experience neck pain. With regard to headache, Jensen, in a review of the epidemiological literature[3], found that the lifetime prevalence in the general population was 78%, while the 1 year prevalence was 74%. The point prevalence on a randomly selected day was 11%.

It can be seen that, when considered together, neck pain and headache are at least as common, and perhaps more common, than low back pain. And the costs ($57 billion annually for headache alone[4]) also rival those of low back pain.

The purpose of this paper is to present a clinical model for the evaluation and management of patients with various cervical spine syndromes. This model attempts to establish a working diagnosis by looking at the patient as a whole while seeking to detect the specific clinical factors that are contributing to the symptom picture in each case. A management strategy can then be developed based on this working diagnosis. The strategy also keeps the "big picture" in mind while applying specific treatment methods to the most important factors involved. Strict assessment of the outcome

of the management strategy is essential in determining whether positive changes are being made or whether modifications of the diagnosis and/or the management strategy need to be instituted.

Diagnosis

In the model presented here, it is considered that effective management of any physical condition is dependent on accurate diagnosis. The challenge with disorders of the cervical spine, however, is that, first, the etiology is often multifactorial, and second, there are often no objective findings are that demonstrable on diagnostic tests such as imaging, blood tests, etc. But it is felt by this author that meticulous history taking and examination can, in most cases, allow the physician to establish a working diagnosis which can then be tested with a trial of treatment.

In this paper, a clinical model is presented in which specific factors are obtained from the history and examination that allow the clinician to make as specific diagnosis as possible. Some of this information can be detected by clinical tests that have adequate reliability and validity, others that have low reliability and validity, and still others for which the reliability and validity have not been tested.

The Three Essential Questions of Diagnosis

In the model presented here, the purpose of the history and physical examination is to answer the three essential questions of diagnosis[5]. These are as follows:

1. Are the symptoms with which the patient is presenting reflective of a visceral disorder, or a serious or potentially life-threatening disease?
2. What tissue(s) is (are) the primary source(s) of the patient's symptoms?
3. What has gone wrong with the patient as a whole that these symptoms would have developed and persisted?

Ruling Out Red Flags

The first essential question of diagnosis seeks to determine whether the patient has signs or symptoms of a disorder that requires further diagnostic testing or referral. There are certain visceral disorders and serious illnesses for which pain in the cervical area is their primary (or, in some cases, only) initial symptom. It is important that meticulous history taking and examination assess for the possible presence of one of these disorders. Referred pain to the cervical, scapular or upper extremity areas can be seen with hiatal hernia, cardiac disease, pancreatic disease, esophageal disorders, gall bladder disease, gastric ulcer and lesions of the mediastinum or lung[6].

Tables 1-4 list those history and examination findings reflective of serious or potentially life threatening disease that are most important to look for in patients neck/ arm pain and headache.

Table 1. Red Flags for potentially serious conditions in neck pain patients - history. Adapted from Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill 2000

Finding	Suggestive of
Major trauma such as MVA or fall from a height	Fracture
Minor trauma in an older or potentially osteoporotic patient	Fracture
Age over 50 or under 20	Tumor or infection
History of cancer	Metastatic disease
Constitutional symptoms such as recent fever, chills or unexplained weight loss	Infection or tumor
Recent bacterial infection, IV drug use, or immune suppression, such as from steroids, transplant or HIV	Infection
Pain that has no mechanical exacerbating or remitting factors	Infection or tumor
Symptoms in both the upper and lower extremities	Myelopathy

Table 2. Red flags for potentially serious conditions in neck pain patients - examination. Adapted from Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill 2000

Finding	Suggestive of
Pinpoint tenderness of the spinous process	Fracture or infection
Fever	Infection
Hyperreflexia with upgoing toes	Myelopathy
Palpable mass	Infection or Neoplasm
Horner's syndrome	Tumor

Table 3. Red flags for potentially serious disease in headache patients - history. Adapted from Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill 2000

Finding	Suggestive of
Sudden onset of severe headache in a patient who is not typically a headache sufferer	subarachnoid hemorrhage
Changes in mood, personality or mentation	Tumor or infection
Dysphagia, dysarthria, vertigo or other bulbar symptoms	Tumor or vertebrobasilar dissection
Emesis	Tumor, infection, intracranial bleed or vertebrobasilar dissection
Induced by coughing, sneezing straining or bending forward	Tumor or infection
History of cancer	Metastatic disease
Seizure	Early stage of tumor
Age over 50	Temporal arteritis, stroke
Visual loss	Glaucoma or other ocular disease

Table 4. Red flags for potentially serious disease in headache patients - examination. Adapted from Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill 2000

Finding	Suggestive of
Fever	Infection
Pappiledema	Tumor
Visual field abnormalities	Tumor
Exquisite scalp tenderness	Tumor
Hyperreflexia with upgoing toes	Tumor or infection
Nuchal rigidity and/or positive Kernig's sign	Meningitis
Enlarged, tender temporal artery	Temporal arteritis
Leak of fluid from nose or ear with recent trauma	Skull fracture

Identifying the Primary Pain Generator(s)

The second essential question involves identifying those specific tissues and clinical entities that are responsible for generating the pain. In many patients, there may be more than one, so a careful search is necessary. There are some who feel that specific pain generators cannot be identified on examination in the majority of spinal pain patients, but there is good evidence that, particularly in the cervical spine, reliable and valid procedures are often available to the trained practitioner.

It is suggested here that there are 4 clinical entities that most commonly serve as pain generators in the cervical spine:

1. Joint dysfunction
2. Myofascial trigger points (TrPs)
3. Disc derangement
4. Neural tension or irritation

The examination process that searches for the primary pain generator(s) is carried out through the use of provocative maneuvers designed to stress or stimulate certain tissues, attempting to provoke pain responses. The goal of this part of the examination is to reproduce the patient's pain, i.e., cause pain that is concordant with that of which the patient is complaining.

1. Joint dysfunction:

It is ironic that although joint dysfunction (some would use the term subluxation) plays a central role in many chiropractic practices, it has never been definitively demonstrated that this entity actually exists. However, it has been repeatedly shown that pain often arises from the cervical zygapophyseal joints (z joints)[7-9] and joint dysfunction seems to be a reasonable model for a possible cause of this pain.

Joint dysfunction is defined as, "loss of joint-play movement that cannot be produced by voluntary muscles"[10]. It is not clear what causes this theoretical loss of joint play although several potential mechanisms have been suggested[11]. It is theorized that joint dysfunction leads to dysafferentation[12], in which the normal balance between afferent input from nociceptors and that from mechanoreceptors in the joint capsule occurs as a result in the loss of normal joint motion. However, because of the paucity of mechanoreceptors that exists in the cervical z joints[13], it is possible that muscle spindles are involved. One of the results of dysafferentation is believed to be nociceptive signals being projected to higher centers relatively unchecked, setting up an environment that can lead to pain experienced in the involved joint. Another result of dysafferentation is believed to be alteration of muscle tone in the muscles related to the involved joint[14]. This will be discussed later.

Painful joint dysfunction is identified by knowledge of the pain patterns that can arise from each segment of the spine, combined with joint palpation. While there is significant overlap of the pain patterns that are related to the zygapophyseal joints of the cervical spine[15,16], subtle differences can help the doctor to pay particular attention to certain segments (figure 1).

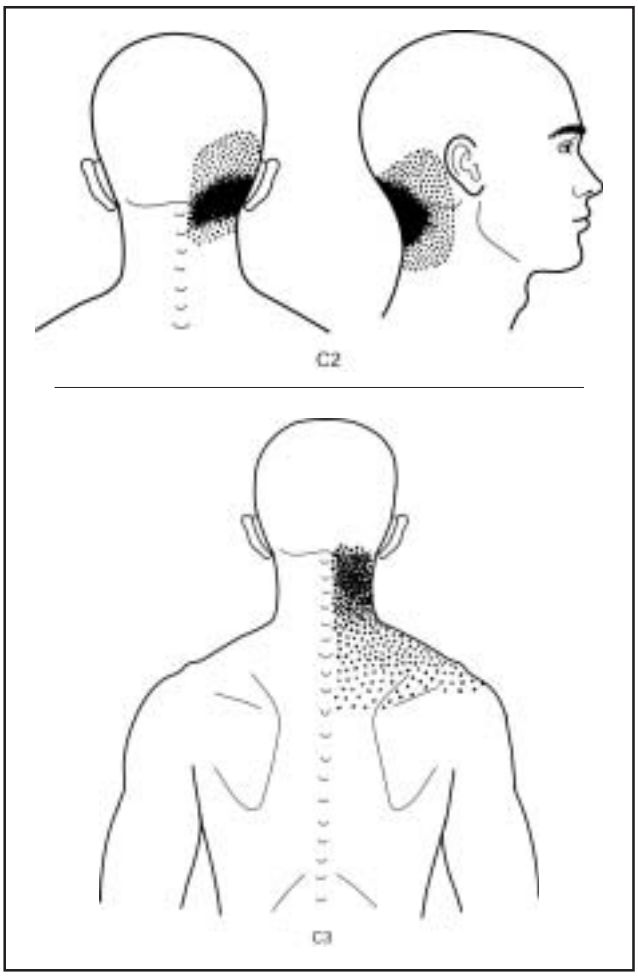


Figure 1. A. Referred pain pattern of the intervertebral tissues at the C2 level. B. Referred pain pattern of the intervertebral tissues at the C3 level. Reprinted with permission from: Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill, 2000 and adapted from Feinstein B, Langton JNK, Jameson RM, et al. Experiments on pain referred from deep somatic tissues. J Bone Joint Surg 1954; 36A(5):981-97

Contrary to the belief of some, cervical z joint palpation can be carried out reliably, and with some validity. However, the procedure must be performed in a meticulous fashion by

trained persons. It is essential that the examination includes both joint motion and provocation of pain[17]. When both these criteria are used, cervical joint palpation has been found to be both reliable[18] and valid[19]. It is also important that the palpating fingers are placed as directly as possible on the involved joint, after moving the overlying muscle out of the way (figure 2).

Cervical joint pain can also be identified with injection of anesthetic[9,20]. With this procedure, anesthetic is injected into suspected joints in the cervical spine and it is determined whether this reduces or abolishes the pain. For most reliable results these should be double blocks with short- and long-acting anesthetic, but it is this author's experience that even single blocks can be useful to raise the level of suspicion as to which joint is producing pain. Interestingly, one study[21] showed a 100% correlation between single blocks and skilled palpation, using the palpation criteria discussed above. As such, it is only uncommon that injection is required to identify pain arising from the cervical zygapophyseal joints. However, in patients in which some question remains after meticulous examination or a failed trial or treatment, injection can prove to be useful.

Haas, et al[22] found no difference in pain relief from manipulation that was based on cervical z joint palpation compared to manipulation that was not based on z joint palpation. However, the palpation involved "endplay assessment", and did follow the protocol discussed here. Also, the study only assessed the immediate response to a single manipulation. Because of this, firm conclusions cannot be drawn from this study.

Figure 2. Joint palpation in the cervical spine. Note that the overlying tissues are moved out of the way and the attempt is being made to place the palpating fingers as closed to the zygapophyseal joints as possible. Reprinted with permission from: Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill 2000

2. Myofascial Trigger Points:

A TrP is defined as "a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. The spot is painful on compression and can give rise to characteristic referred pain, tenderness and autonomic phenomena."[23] Examination of TrPs requires both the knowledge of the known TrP pain referral patterns and skilled palpation of those muscle suspected to be involved. The referred pain patterns from TrPs are fairly predictable and consistent from patient to patient. So once the patient has identified the specific location of his or her pain, via pain

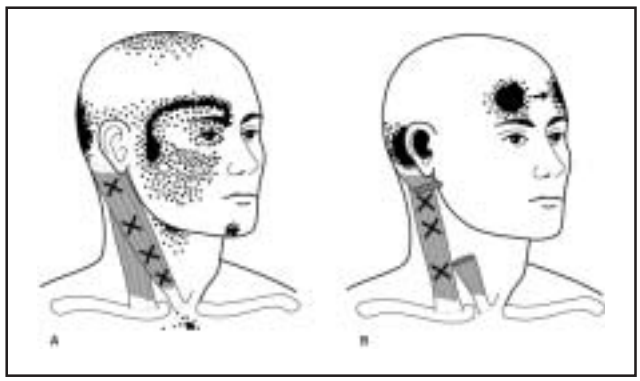


Figure 3. Referred pain pattern of trigger points in the sternocleidomastoid muscle. Reprinted with permission from: Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill, 2000 and adapted from Travell JG, Simons DG. Myofascial Pain and Dysfunction: The Trigger Point Manual. Vol 1. Baltimore: Williams and Wilkens 1983

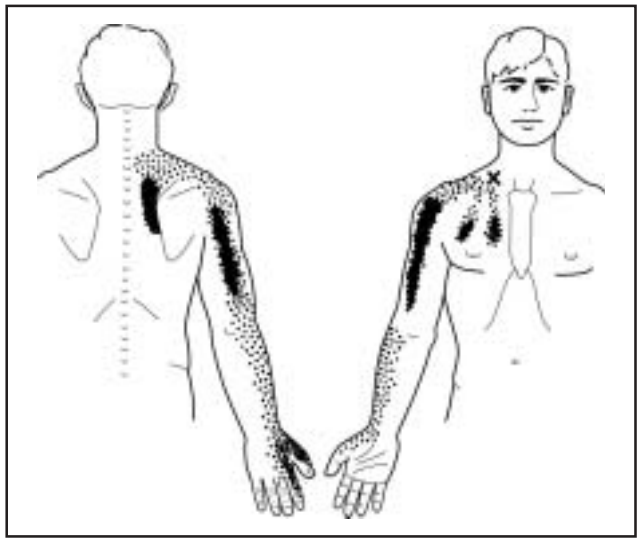


Figure 4. Referred pain pattern of trigger points in the scalene muscle. Reprinted with permission from: Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill, 2000 and adapted from Travell JG, Simons DG. Myofascial Pain and Dysfunction: The Trigger Point Manual. Vol 1. Baltimore: Williams and Wilkens 1983

drawing as well as by pointing to the area of pain, the doctor can determine which muscle or muscles are to be examined. For example, if the patient describes headaches that are located over the forehead and face, the doctor would want to examine the sternocleidomastoid (figure 3). If the patient's pain pattern is that of radiating pain into the arm, it is wise to examine the scalenes (figure 4).

In general, good inter-examiner reliability has been found for palpating cervical muscles for TrPs[24-26]. As there is no "Gold Standard" for the identification of pain from muscle, assessing validity of TrP palpation is difficult.

3. Disc Derangement:

Disc derangement is thought to occur when the nucleus pulposis becomes displaced from its central position in the disc to the periphery[27]. This "disc model" is somewhat controversial, particularly with regard to the cervical spine[28] and may require refinement with future research. But it still serves the purpose of allowing one to conceptualize one's clinical findings. Disc derangement in the cervical spine may be identified by utilizing the McKenzie protocols of end range loading, looking for a pattern of peripheralization and centralization of pain[29]. Mechanical impedance to movement in the direction of centralization is typically seen. It has not been demonstrated that this examination procedure implicates disc pain in the cervical spine, but positive correlation between the McKenzie examination and discogram has been found in the lumbar spine[30,31], suggesting that the findings on this examination protocol successfully identified disc pain in the majority of patients with low back pain. Likewise, the reliability of the core aspects of the McKenzie assessment procedures are generally good with regard to the lumbar spine[32,33], but they have not been evaluated in the cervical spine.

Discogram has long been considered the "gold standard" for the diagnosis of disc pain in the lumbar spine[34] (though this has recently been questioned[35,36]), but its role in identifying disc pain in the cervical spine is less clear[37]. It is, however, considered by many to be an effective tool in diagnosing disc pain in those patients in whom clinical examination is not definitive, and a trial of non-surgical treatment fails. Great skill and proper protocol are essential in gaining the highest quality information from cervical discogram[38,39]. Nonetheless, in the majority of patients, discogram is not necessary.

4. Neural tension or irritation:

Neural tension is believed to result either from adhesions that form somewhere along the course of the nerve[40] or some other pathological process that may cause depolarization of the nociceptive receptors of the nervi nervorum[41]. However, much work needs to be done to investigate the pathophysiology of neural pain. Neural irritation is commonly found in patients with radiculopathy secondary to herniated disc and in these cases is largely chemical in nature[42]. The examination for neural tension or irritation is particularly important in patients with neck pain and pain referring into the upper extremity, but neural tension is sometimes found to be a factor even in patients whose pain is primarily axial. As was the case with joint dysfunction and TrPs, history is useful in asking the patient to identify the location of the pain[43]. This can be done by asking the patient to use one finger to identify the location of the pain, or with a pain drawing.

Provocation tests are also useful in identifying neural tension or irritation. Perhaps the most important and widely used test is the Brachial Plexus Tension Test (BPTT), also referred to as the Upper Limb Tension Test[44]. With this test, the upper extremity is taken through a series of movements designed to apply tension to the brachial plexus and its nerve roots and branches. While these movements are being made, the degree of tension that is developed is felt by the examiner and the patient is asked about the provocation of pain. The maneuvers can be made specific to the main peripheral nerves of the upper limb by introducing a median, ulnar or radial bias. The general test that is most commonly used is that which biases the median nerve.

It is important to note that pain and increased muscle tension during the BPTT is regularly found in asymptomatic individuals[45], so it is important to compare the findings on the involved side to the uninvolved side (in patients with unilateral cervicobrachial pain) and to ask the patient not only if the maneuver causes pain, but whether it reproduces the pain with which the patient is presenting.

When the neural tension is arising from radiculopathy, which most commonly results from either lateral canal stenosis or herniated disc[46], there are other provocative maneuvers that are helpful, and when a combination of tests are used, the reliability and validity of the findings are greatly increased. Wainner, et al[47] demonstrated that the most useful cluster of tests for detecting cervical radiculopathy were the BPTT with a median bias, limitation of active cervical rotation to the painful side of less than 60 degrees, "Spurling's test" (downward pressure on the head with the head bend toward the side of pain, also known as the Maximum Cervical Compression test) and Distraction test (relief of pain with long axis distraction in the seated patient).

With regard to imaging, MRI is the modality of choice in detecting the anatomical abnormality responsible for radiculopathy[48], be it from lateral canal stenosis or herniated disc. It also helps with differential diagnosis, specifically ruling out space occupying lesion such as tumor or infection, and cervical spondylotic myelopathy. In many cases, however, MRI is not necessary to make the diagnosis, unless the clinical picture is not entirely clear from history and examination. Electrodiagnostic testing is sometimes helpful in confirming the diagnosis and for differentiating between radiculopathy and peripheral neuropathy[49].

Neural tension can also arise from entrapment of the brachial plexus or peripheral nerves. Common entrapment sites for the brachial plexus are thought to be between the anterior and middle scalenes and under the pectoralis minor muscle[50]. These muscles should be examined in patient who exhibit a positive BPTT.

Identifying Perpetuating Factors

The third essential question of diagnosis involves assessing a variety of factors that may serve to either cause the primary pain generator(s) to continually generate nociception or to sensitize the patient to continued pain experience. Little work has been done to definitively identify factors that serve to perpetuate cervical spine syndromes. Suggested here are several factors that, based on some experimental data and clinical experience, may play an important role. They generally fall into the following categories:

1. Dynamic instability
2. Faulty movement patterns
3. Oculomotor dysfunction
4. Central pain hypersensitivity
5. Fear avoidance beliefs and behavior

1. Dynamic instability:

Much has been written in recent years about spine stability and instability, and a change has taken place as to what factors are most important in the maintenance of spine stability and what constitutes spine instability.

Stability of the cervical spine must be maintained at all times. Even simple movements common to every activities are enough of a perturbation to cause the entire spine to collapse without an intact stability system[51]. Thus, stability responses are generated on an ongoing basis. Intricate muscle coordination is required for the spine stability system to maintain control of the intersegmental joints in response to the varying types and magnitudes of perturbations to which the spine is subjected on a daily basis. When there is a breakdown in the fine motor control that is required to protect the spine in response to perturbation, dynamic instability results. Dynamic instability is distinguished here from passive, or ligamentous, instability, in which "overstretching" of the spinal ligaments takes place. The spinal ligaments only provide stability at end ranges, if at all[36] and it is thought that the dynamic stability system is far more important in protecting the spine against injury on an ongoing basis[52].

Dynamic instability is thought to arise from a variety of sources. In the lumbar spine, repetitive cycles of flexion or prolonged flexion have been shown to cause a delay in the dynamic stability responses of the multifidis muscles[53,54]. Compression combined with vibration has also been shown to cause this delay[55]. It is hypothesized that joint dysfunction, as discussed earlier, may alter the tone of the muscles associated with that joint, which can lead to instability[56]. Finally, it is possible that a sudden bombardment of nociceptive impulses, as occurs with a whiplash injury, can cause the motor program for stability responses to become altered[57]. As a result, the spine is left vulnerable to injury.

While much still needs to be discovered about the mechanism of cervical stability and instability, as well as how to detect instability, it appears that there are certain muscles that are involved in cervical stability which tend to become inhibited. These muscles are the deep cervical flexors[58] and the lower cervical and upper thoracic extensors. In the lumbar spine, the multifidi have been found to become inhibited[59,60], so they are considered important in the cervical spine as well, though further work is required to clarify this.

In addition to cervical stability, scapular stability appears to be important in many cervical patients[61]. As with other areas of the body, there are certain scapular stability muscles that tend to easily become inhibited, specifically the lower and middle trapezius and serratus anterior[62].

Dynamic instability may detected through examination procedures that test the holding capacity of the muscles believed to be important in stability. These include the cervical stability test, the shoulder abduction test, the push up test and others[63].

2. Faulty movement patterns:

A faulty movement pattern is an alteration in the pattern of contraction of muscles when an individual carries out a movement. The concept of faulty movement patterns was originally developed by Janda[64] and has generated great clinical interest, although little work has been done to validate the concept or to determine whether faulty movement patterns actually put an individual at risk for injury.

3. Oculomotor dysfunction:
Oculomotor dysfunction has been repeatedly found to be a feature in patients with chronic neck pain after trauma such as whiplash injury[65-69]. It has also been found in patients with chronic tension type headache[70,71]. Because it tends to be found in whiplash patients who do not recover compared to those who do, it is speculated that this phenomenon may serve as a perpetuating factor for continued pain after whiplash. The most common oculomotor reflexes that have been studied in patients with chronic neck pain are smooth pursuit and saccade reflexes.

Oculomotor dysfunction cannot be detected directly in most clinical settings, but Heikkila and Wenngren[72], in chronic post whiplash patients, found a significant correlation between poor performance on oculomotor tests and on Revel's test for cervical repositioning. Revel's test can be easily performed in most offices[63].

4. Central pain hypersensitivity:
Central pain hypersensitivity is a phenomenon in which the nociceptive system becomes hypersensitive, thus heightening the individual's pain perception[73]. This usually results from either a single intense bombardment of nociceptive impulses, such as whiplash, or lower level, continuous input, which is believed to occur with joint dysfunction[8] and instability[74]. Changes occur in the dorsal horn[75], the cerebral cortex[76] and the descending nociceptive modulation system[77] that allows nociceptive information to be projected to higher centers relatively unchecked, renders nociceptive neurons more receptive to incoming signals, and allows non-nociceptive information to be transmit along nociceptive pathways.

5. Fear avoidance beliefs and behavior:
It is becoming increasingly understood that fear plays an important role in the perpetuation of many spinal pain syndromes. Although fear appears to play a more important role in the perpetuation of low back pain than neck pain[78], it still can be a critically important factor in many patients with neck pain, especially those whose pain originally resulted from trauma[79].

There are several questionnaires that are effective in detecting fear avoidance beliefs. These include the Fear Avoidance Beliefs Questionnaire[80] and the Tampa Scale for Kinesiophobia[81].

"Behavioral signs" or "nonorganic signs" have long been thought to be important indicators of a significant behavioral component to chronic cervical (or low back) pain. Sobel, et al[82], adapted the well-known Waddell's nonorganic signs to the chronic cervical pain patient. This examination process involves 5 categories, and when 3 or more of these categories contains positive findings, it has been considered that illness behavior is playing a potentially prominent role. However, whether Waddell's nonorganic signs in low back pain truly represent significant "abnormal illness behavior" has recently been questioned. In a recent thorough review of the literature, Fishbain, et al[83] concluded that Waddell's nonorganic signs, as they apply to the low back pain patient, likely do not signal the presence of abnormal illness behavior or a psychological disorder, but rather reflect the behavioral manifestation of central pain hypersensitivity. Because of this, it is reasonable to also question whether cervical nonorganic signs actually indicate the presence of a behavioral abnormality. They may, however, be important in identifying the presence of central pain hypersensitivity. More work in this area should help to clarify this issue.

The accuracy with which the three essential questions of diagnosis are answered determines the extent to which the assessment of the patient is successful. An attempt is made to use tests with a high degree of reliability and validity. But because some of the tests that are used to derive answers to these questions are not completely sensitive and specific, or their sensitivity and specificity are unknown, the diagnosis that is developed as a result of the answers to the three questions must be a working hypothesis that can then be tested with the management strategy.

Testing this diagnostic hypothesis with treatment must involve the use of reliable and valid outcome measures. These measures allow the physician to effectively determine whether the management strategy is producing worthwhile clinical changes in perceived pain and capacity for carrying out activities of daily living.

Outcome Assessment
It is important to closely monitor the results of management of the patient's condition. This should focus on factors related to the patient's daily function. There are simple and effective tools that allow the doctor to quantify the degree to which the patient's life is affected by the particular cervical syndrome. These come in the form of questionnaires that usually take the patient a few minutes to fill out and the staff a minute or so to score.

Probably the most commonly used cervical outcome questionnaire is the Neck Disability Index[84]. A questionnaire that is simpler to use and score is the Bournemouth Neck Disability Questionnaire[85]. This consists of 7 questions, each of which contains a numerical rating scale that allows the

patient to answer each question on a scale of 0 to 10. Less commonly used questionnaires include the Copenhagen Neck Functional Disability Scale, and the Northwick Park Scale[86].

All these questionnaires have good reliability, validity and psychometric properties[86]. This author currently uses primarily the Bournemouth questionnaire because of its ease of application and scoring.

Pain intensity can be measured with a numerical rating scale, in which the patient rates his or her pain on a scale of 0 (no pain) to 10 (unbearable pain). There are those who advocate a multi-tiered numerical rating scale, in which the patient rates the pain currently on one scale, on average on another, at its best on a third and at its worst on a fourth. Bolton and Wilkinson[87] found that having the patient rate the average pain over the past week has better responsiveness that having the patient rate the current pain. It is this author's experience that both for clinical and research purposes, using this single scale is more accurate and less error-prone than the multi-tiered scales.

The patient fills out the outcome instruments at the initial visit. He or she then fills them out again at the reexamination visit and the scores at the reexamination can be compared with those at the original visit.

Management

Again, the answers to the 3 essential questions of diagnosis allow for the development of a management strategy that is based on the findings of the history and examination. If there is suspicion of a non-neuromusculoskeletal cause of the patients symptoms, further investigation and/or referral for further evaluation must be made. If there are not, then the management strategy moves to the answers to the second question, i.e., the primary pain generator(s).

The evidence of efficacy for each of the presented treatment approaches is provided, to the extent to which such evidence is available. But it is suggested here that the strength of these treatment approaches lies not in their use in isolation, but as part of an overall management strategy, in which each method is used as a tool to address certain aspects of the clinical picture that may be important in any individual patient. As such, some of these treatment approaches may be used in certain patients, and other approaches in other patients. Some methods will be used in isolation at times and other times in combination with other methods. This is determined by the assessment process, in which specific pain generators and perpetuating factors are uncovered.

Addressing the Pain Generators

1. Joint dysfunction:

The treatment of choice for joint dysfunction is manipulation. Manipulation is designed to move the dysfunctional joint, thus improving joint motion[88,89], decreasing pain[88-91], improving neurophysiologic function[92] and helping to normalize muscle tone[93-96]. There is substantial evidence that manipulation is a useful tool in the treatment of patients with cervical spine syndromes[97-100]. As chiropractic physicians are well trained in both the theoretical and practical aspects of manipulation, this will not be discussed further.

A more invasive approach to cervical zygapophyseal joint pain is radiofrequency neurotomy. With this procedure, an electrode is used to heat the nerve or the dorsal root ganglion that innervates the involved joint. This causes the nerve structure to denature, thus anesthetizing the joint. As the evidence of effectiveness of this procedure is limited[101] and the effect is usually temporary[102], this procedure should be limited to those patients in whom the other measures discussed here are not successful.

2. Myofascial trigger points:

There are several treatments for TrPs. Perhaps the most effective is ischemic compression. With this treatment, direct pressure is applied to the TrP to the point at which the patient's pain is reproduced. This pressure is either maintained until the pain resolves[23] or is held for several seconds[103]. In a randomized, controlled trial, Garvey, et al[104], compared injection of 1% lidocaine, injection of 1% lidocaine with Aristopan, insertion of dry needle (acupuncture) and ischemic compression combined with topical vapocoolant spray. They found significant superiority of the ischemic compression treatment compared to the others. Hong, et al[105] found ischemic compression to be more effective than spray and stretch using vapocoolant, ultrasound and hydrocollator in the treatment of TrPs.

Muscle lengthening procedures, including spray and stretch and postisometric relaxation are also often useful in treating TrPs[106]. Trigger point injection may be used in those patients who do not respond to the previously mentioned treatments.

3. Disc derangement:

The treatment of derangement is end range loading of the cervical spine in the direction of movement in which mechanical impedance was found and which caused the patient's symptoms to centralize or reduce in intensity, according to the McKenzie protocol[29]. Evidence supports the use of the McKenzie protocols in patients with acute and chronic neck pain[107,108].

4. Neural tension or irritation:
The treatment for neural tension or irritation will depend, in part, on the underlying cause of the symptoms. In the case of acute radiculopathy resulting from herniated disc or lateral canal stenosis, it is important to reduce inflammation as quickly and thoroughly as possible. There are several methods that are helpful to this end. Ice application can be done by the patient at home, and is a time-honored method of reducing inflammation. Nonsteroidal anti-inflammatory medications are useful as well[109]. Epidural steroid injections (ESI) will often cause dramatic, though short term, decrease in inflammation and pain and should be strongly considered in those patients who do not respond immediately to the less invasive anti-inflammatory approaches[110].

Manipulation can be a useful tool in patients with cervical radiculopathy[111]. Theoretically, this helps to correct joint dysfunction, thereby reducing the pain from the dysfunction, improves segmental mobility to allow better flow of fluids, and, importantly, reduce acute pain.

Over-the-door traction can be an effective method by which the patient can reduce nerve root pressure at home[112]. This is also powerful in that it allows the patient to gain a feeling of control over the pain, as he or she is able to self-apply this pain relief measure.

In the subacute and chronic patients, neural mobilization is often helpful[113]. This involves gentle repetitive movements of the nerve root/ peripheral nerve complex into the direction of restriction and pain[114]. There are various maneuvers that can be used, including the lateral glide mobilization, which may allow one to target the nerve root, and distal brachial plexus mobilization, which theoretically affects the brachial plexus more globally. A more complete explanation of the theory and clinical application of neural mobilization can be found in the book by Butler[115].

Addressing Perpetuating Factors

Once an adequate reduction of pain is achieved, the answer to the third essential question of diagnosis can be addressed. That is, an approach can be taken toward any suspected perpetuating factors that were found during the assessment process. As with the treatment of pain generators, it is best that this approach be as specific to the identified perpetuating factor as possible; the management strategy must be specified to the patient's needs.

1. Dynamic instability:
The approach to suspected instability is stabilization training[116]. Stabilization training is an exercise method that is designed to help the dynamic stability system of the cervical spine to function at optimum. Different approaches have been used for cervical stabilization training[117,118], each with evidence of effectiveness. What is described here is an approach that was developed in part by the author and derived in part from other sources.

The exercise process being used and studied by this author starts with a maneuver called a cervical brace, in which an attempt is made to train the quadruped patient to co-contract the deep cervical flexors and lower cervical and upper thoracic extensors (figure 5). Once the patient is able to maintain this co-contraction, he or she is begun on a progression of extremity movements (figures 6A and B), balancing a small hardcover book on the back of the head (figure 7). Ultimately, the patient can be progressed to

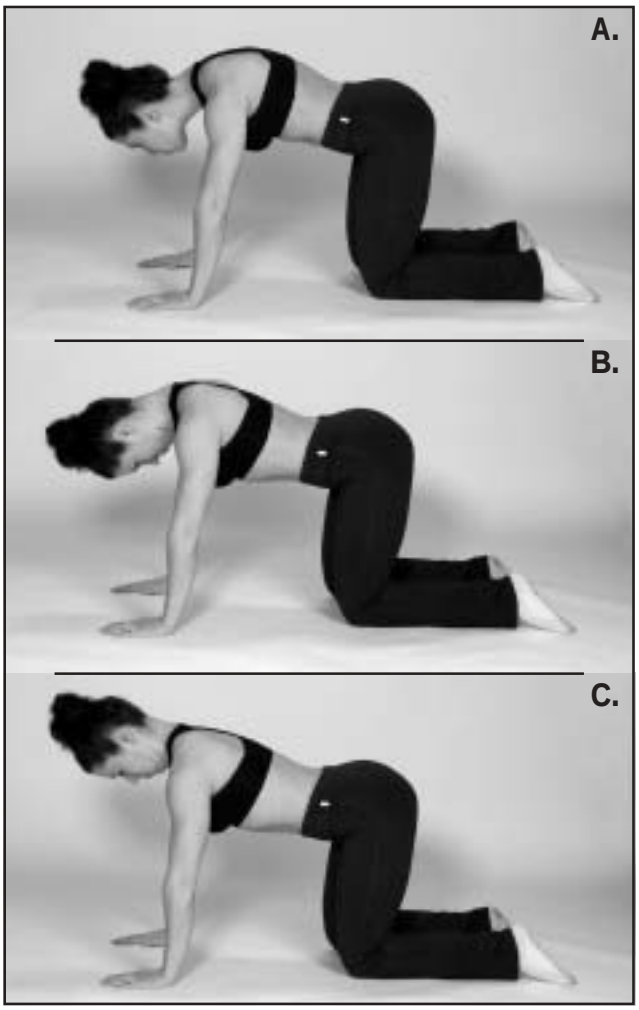
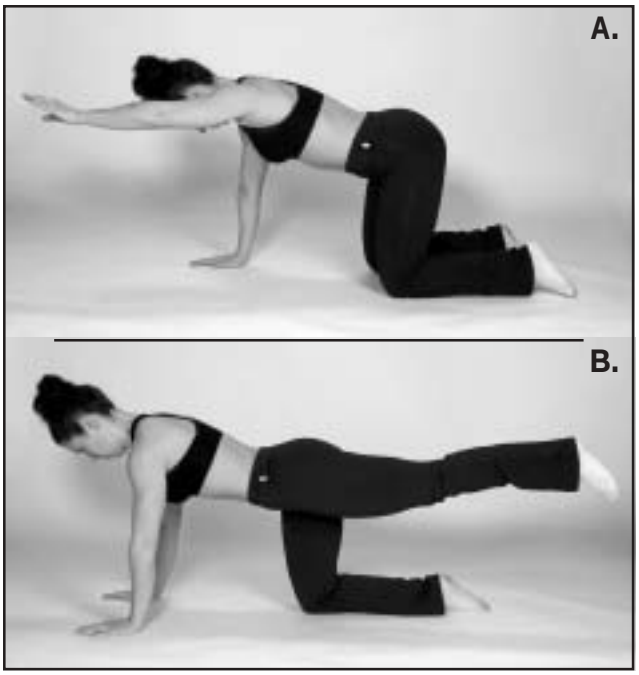


Figure 5. The cervical brace. A. The patient first protracts the head, then in a fluid scooping motion flexes the upper cervical spine (B) and extends the lower cervical spine (C) to return to the neutral position. Reprinted with permission from Murphy DR, Ierna G. Cervical spinal stabilization exercises. Self Published 2003.



Figures 6A & 6B. Arm and leg movements while maintaining the cervical brace. Reprinted with permission from Murphy DR, Ierna G. Cervical spinal stabilization exercises. Self Published 2003.

Figure 7. Maintaining a cervical brace while balancing a small book. Reprinted with permission from: Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill 2000.

performing the extremity movements while balancing the book. Scapular stabilization can also be performed, targeting those scapular stability muscles that tend to become inhibited.

2. Faulty movement patters:

It is thought that faulty movement patterns can be addressed through therapeutic exercises designed to teach the patient to more effectively carry out the movement in question, or with sensorimotor training. Sensorimotor training is a method that uses unstable surfaces such as a wobble board on which the patient stands (figure 8). Exercises and practitioner-initiated maneuvers can then be applied. The theory behind sensorimotor training is that it causes an afferent bombardment of somatosensory signals from various mechanoreceptors in the locomotor system, helping the central nervous system to optimize the motor programs that govern the various movement patterns in which the individual engages during everyday activities[116]. Little work has been done to investigate this proposed mechanism, or the outcome of sensorimotor training.

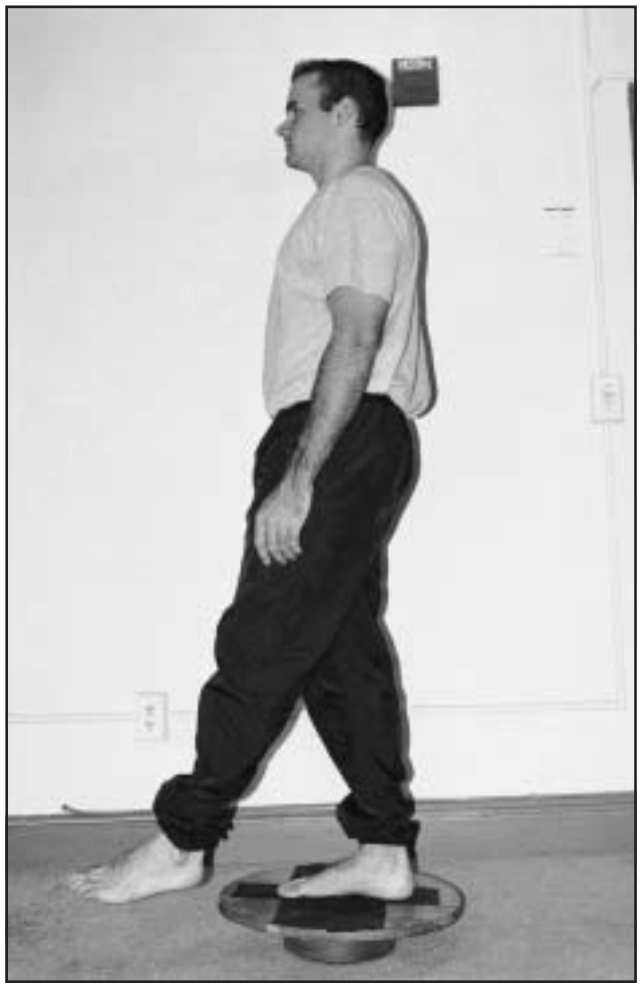


Figure 8. One legged stand on a wobble board. Reprinted with permission from: Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill 2000.

3. Oculomotor dysfunction:

Oculomotor dysfunction can be addressed with exercises that train eye-head-neck coordination. These can be non-specific, such as Fitz-Ritson's "Phasic Exercises"[119] or can be made specific to those oculomotor reflexes that have been shown to frequently become dysfunctional[116]. This author combines oculomotor reflex training with sensorimotor training to take

advantage of the heightened central nervous system activity that a wobble board provides (figure 9).

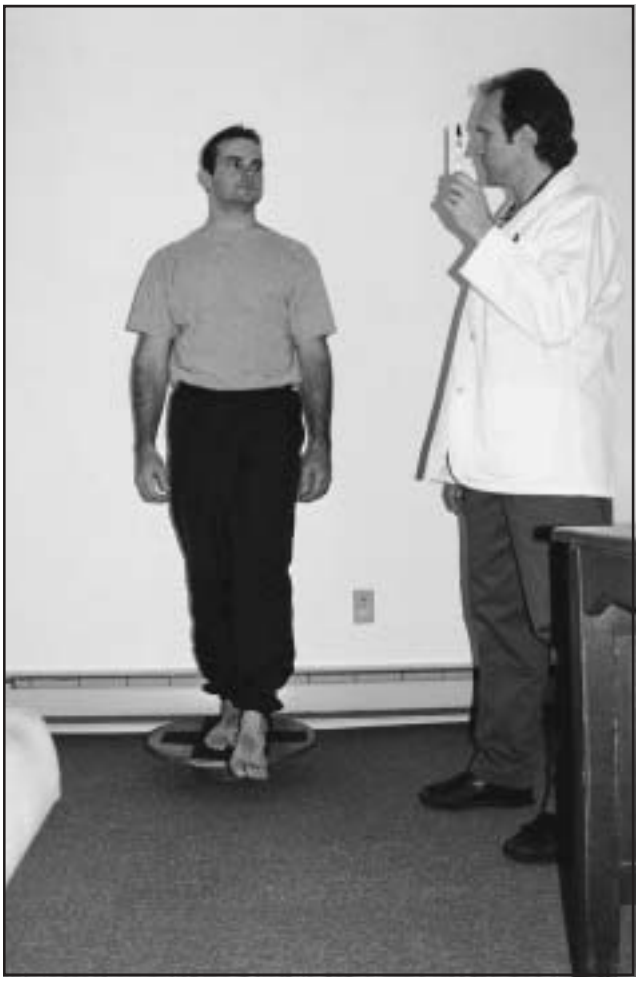


Figure 9. One legged stand on a wobble board with the introduction of smooth pursuit movements. Reprinted with permission from: Murphy DR, ed. Conservative Management of Cervical Spine Syndromes. New York: McGraw-Hill, 2000.

Fitz-Ritson[120] found that patients with chronic neck pain after whiplash who were treated with standard chiropractic treatment with the inclusion of Phasic Exercises had more greatly improved outcomes than those treated with standard chiropractic treatment alone. Humphreys and Irgens[121] also found greater improvement in both pain levels and in the findings of Revel's test in patients with chronic neck pain treated with oculomotor exercises compared to a non-exercise group.

4. Central pain hypersensitivity and fear avoidance beliefs and behavior:

While research on the management of central pain hypersensitivity and fear as it relates to patients with cervical spine syndromes is sparse, clinical experience suggests that these must be addressed mutlifactorially. The approach focuses on desensitizing both the nociceptive system and the patient's fear[122]. First, the more rapidly nociception is detected and reduced, the sooner one can attempt to desensitize the nociceptive system and the belief system to activities. Next, addressing the other perpetuating factors is considered essential to creating an environment in which the individual can function more effectively in his or her everyday activities with less interference by pain.

In addition to this, education is of the utmost importance when managing the patient with a high degree of central pain hypersensitivity and fear-avoidance beliefs. This helps with the central pain hypersensitivity in that it helps the patient to understand that the pain experience he or she is having is not necessarily reflective of the severe "tissue damage" that appears to be present. Rather, the pain experience is simply a reflection of the nociceptive system amplifying the pain; in effective, the patient's nociceptive system is lying, or at least exaggerating, to the patient. Educating the patient in this way may help reduce fear of movement and activity, as often the fear relates to the "damaged tissue" being moved "the wrong way", with severe and possibly permanent injury resulting. Once the patient understands clearly that there is no "damage", only "dysfunction", the fear can gradually be put to rest.

However, this education must be reinforced with experiential evidence that the patient can engage in activities which he or she currently believes are dangerous. Thus, a "graded activity"[122] approach is used. With this approach, the patient is gradually introduced to movements or activities (in the typical office setting, this can often be done with rehabilitative exercises or with activities of daily living) that produce pain related to central pain hypersensitivity or that engenders fear (or, as is often the case, both) but to a level that he or she can handle. The patient then performs this activity repeatedly until he or she becomes less sensitive. The intensity of the activity can then be increased to allow further desensitization to take place. In severe cases, a multidisciplinary operant conditioning approach[123] is required in which a similar process in undertaken but with the help of behavioral psychologists.

Conclusion

The purpose of this paper was not to provide a comprehensive look at the diagnosis and management of patients with chronic cervical disorders, but rather to present an overview of an evidence-based model to the approach to these patients. Central to this model is the notion that the etiology of most chronic cervical disorders is usually multifactorial, and thus

the approach to diagnosis and management must consider the many factors that can be present in each case. The model takes a systematic approach to diagnosis, based on what this author terms the Three Essential Questions of Diagnosis, which leads to the development of a working diagnosis, not of a single lesion, but of the entire clinical picture, including primary pain generators and perpetuating factors. A management strategy is then devised to address those specific factors that were detected on history and examination, in an environment in which the patient is empowered to self manage whenever possible.

Research into individual components of this model, as well as the model as a whole, is necessary to determine the applicability and effectiveness of the approach. This will allow for alteration or abandonment of any part of the model, as clinical and experimental evidence dictates.

Summary

- A clinical model was presented for the diagnosis and management of patients with syndromes related to the cervical spine. The diagnostic approach is based on three questions, the answers to which help the clinician to determine if the symptoms are arising from visceral disease or serious illness, what the specific pain generating tissues are, and if there are perpetuating factors that may be present.
- A management strategy is then devised that is designed to refer the patient for testing or specialty consultation if visceral disease or serious illness is suspected and to address the pain generating tissues and potential perpetuating factors.
- Clinical and experimental evidence is presented which allows the reader to assess the degree to which the model has face validity.

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