Chronic Whiplash and Whiplash-Associated Disorders: An Evidence-Based Approach

Abstract
Whiplash is neck pain experienced as a result of a motor vehicle collision or similar trauma. Following a motor vehicle collision, 15% to 40% of patients with acute neck pain develop chronic neck pain. The cervical facet joint is the most common source of chronic neck pain after whiplash injury, followed by disk pain. Some patients experience pain from both structures. Initial management recommendations need not be directed toward an exact structural cause, but treatment includes advising the patient to remain active, prescribing medications when necessary, and providing advice regarding the generally favorable outcome. When neck pain persists, the physician should recommend medial branch blocks of the dorsal rami of the spinal nerves that supply the putative painful facet joint or joints; this is done to determine whether the facet joints are the cause of pain. When significant relief occurs on two occasions, radiofrequency neurotomy typically provides substantial relief for approximately 8 to 12 months and can be repeated indefinitely as needed. Occasionally, long-term treatment with medication may be indicated. Anterior cervical diskectomy and fusion is necessary on rare occasions.

The term whiplash has been used to describe both a mechanism of injury (usually a motor vehicle collision [MVC]) and the neck pain caused by that injury. Whiplash-associated disorder is defined as the variety of clinical symptoms other than head, neck, and arm pain that occur after a whiplash type of trauma. In a typical rear-end MVC, the injury is caused by the abnormal biomechanics of neck motion resulting from the forward and upward motion of the torso while the head lags behind as the result of inertia. Whiplash injury is any structural damage sustained because of the whiplash forces.

Most persons involved in an MVC are not injured. Clinical studies have shown, however, that 15% to 40% of patients with acute neck pain after MVC develop chronic pain; 5% to 7% of patients become permanently partially or totally disabled. Whiplash injury remains controversial and misunderstood, despite advances in knowledge of the biomechanical and medical aspects of this condition.
**Mechanism and Biomechanics of Whiplash Injury**

The whiplash event lasts well under 500 ms. In a rear-end MVC, energy is transferred on impact from the bullet vehicle to the struck vehicle; the struck vehicle is then suddenly accelerated by the impact. Energy is transferred to the frame of the struck vehicle, then to the seat, and then to the occupants. The resultant biomechanics have been described. The predominant response to the impact is forward displacement and associated upward displacement of the torso. Head motion lags behind the body as a result of the inertia of the head. The forward acceleration of the torso deforms the cervical spine into a nonphysiologic S-shaped curve, with extension developing between the lower segments and flexion developing between the uppermost segments. Most of the whiplash injury occurs during this deformation phase. The base of the skull is accelerated forward by the neck, causing the head to rotate backward and the upper cervical spine to move into extension. Overall neck extension usually stays within the physiologic range, particularly when the head is well positioned against a head restraint. As a result of head restraint contact, the head and neck rebound forward into cervical flexion.

The forces and resultant motion that cause the whiplash injury are related to neither the total range of motion of the neck nor the amount of extension or flexion—the so-called whip. Instead, it is the abnormal motion that occurs within and between individual motion segments that has the potential to injure facets, disks, and ligaments. The facet joints undergo a nonphysiologic pinching motion, with compression posteriorly and distraction anteriorly, usually coupled with shear. The anulus fibrosus of the disk and longitudinal ligaments can be disrupted by the same abnormal motion.

Facet injuries include capsular strain and tears, bony impingement, synovial fold pinching, and direct-impact injury resulting in contusion, intra-articular hemorrhage, and damage to subchondral bone. Disk injuries include strain or avulsion of the anterior disk anulus, tearing of the posterior anulus, and disk herniation. Any of these structural injuries has the potential to cause acute and chronic neck pain.

The amount of force transmitted from the bullet vehicle to the struck vehicle is often reported as change in velocity. In general, the greater the change in velocity, the greater the injury to the occupants. However, this relationship is far too variable to be of use in predicting severity of injury. Moreover, data indicate that whiplash injury is better correlated with the acceleration of the struck vehicle than with the change in velocity.

Severity of property damage is not a reliable predictor of injury or outcome in low-speed collisions. Crash characteristics and human factors are much more relevant. Crash factors include the respective size, weight, and speeds of the vehicles; the type and position of the seat and head restraint; and the ability of the vehicles to absorb or transmit energy. Human factors include the size, weight, and sex of the occupant; awareness of the impending collision; direction in which the occupant is facing at impact; and individual tissue tolerance.

**Natural History of Neck Pain After Whiplash Injury**

Multiple studies document the natural history of whiplash injury. Most persons do not develop neck pain after an MVC. However, those who experience acute neck pain immediately following the MVC are three times more likely to report chronic neck pain 7 years later than are patients involved in MVCs who had no acute neck pain and patients not involved in a prior MVC. In approximately 80% of patients, pain following an MVC begins the day of the collision. Of those who develop chronic pain, 20% experience delay between the time of the MVC and the onset of pain. The literature reflects a wide range of patients who have acute neck pain after whiplash injury and who recover completely, but the consensus is between 60% and 85%. Up to 40% of patients develop chronic (usually mild) pain, but 5% to 12% experience chronic moderate to severe pain; approximately 5% to 10% have permanent partial or total disability.

Radanov et al prospectively studied 117 patients with acute whiplash. Full recovery was achieved in 56% of patients at 3 months, in 70% at 6 months, and in 76% at 12 months. Of the patients, 21 patients (18%) remained symptomatic; of these patients, 3 were partially disabled and 2 were totally disabled.

**Prognostic Factors**

**General Factors**

Many prospective studies have identified prognostic factors for adverse outcomes. The strongest predictor of poor outcome is high initial intensity of pain. In a systematic review, Scholten-Peeters et al noted that older age, female sex, high initial psychological response, and compensation or litigation were not associated with an adverse prognosis. There was limited prognostic value for the patient with pain in multiple areas or with prior psychosocial problems. Evidence was inconclusive regarding the prognostic value of head position at impact, radicular symptoms, cognitive impairment, poor concentration, prior headache, being unprepared for collision, and a change of velocity >10 km/h [>6.2 mph]. However, Côté et al found that older age, female sex, radicular symptoms, multiple areas of pain, and being unprepared for impact portend a worse prognosis.
Preinjury Psychological Factors

There is no preinjury personality that renders individuals more likely to develop chronic pain after whiplash, nor are there psychosocial factors that are useful predictors of chronicity. Gargan et al recorded symptoms and psychological test scores in 50 patients with acute whiplash within 1 week of MVC and then again at 3 months and 2 years. Psychological testing was normal initially in 82% of patients. At 3 months, testing was abnormal in 81%, and testing remained abnormal at 2 years in 69%. There was no correlation between the initial psychological testing and chronicity. The authors concluded that, in most instances, psychological problems were a consequence rather than a cause of pain.

Coping style may be quite important. Patients with better coping abilities have more favorable functional outcomes than do those who cope poorly. The development of fear avoidance and of fear-avoidant behavior may contribute to the disability of the chronic pain.

Work-Related Factors

Gozzard et al examined factors that might affect employment and disability after whiplash. Forty of 586 patients (7%) had not returned to work. The strongest predictor of prolonged disability was intensity of symptoms. There was no difference in the prevalence of preinjury psychological illness in those who did or did not return to work. Hendriks et al prospectively followed 125 patients with acute whiplash. At 1 year after injury, 12% were partially or totally impaired or disabled. There was no predictive value for baseline initial psychometric testing, litigation status, age, sex, differences in speed between vehicles, or type of early treatment.

Effect of Litigation on Outcome

The effect of litigation on outcome is often misunderstood. Multiple studies have demonstrated that personal injury litigation does not adversely affect the outcome of whiplash injury. One possible reason for confusion might be the failure to discriminate between workers’ compensation and personal injury litigation. It is well-established that, as a group, injured workers tend to do worse than other patients with similar injuries.

Swartzman et al compared the outcomes of whiplash patients in litigation with those of patients who had completed litigation. Active litigants reported more pain than did postlitigants, but no differences were found in function or employment status. Patients with more pain and more objective findings were more likely to file claims. There was no evidence for improvement after litigation was settled. In fact, after settlement, 39% of patients improved, 55% showed no change, and 5% got worse. Sapir and Gorup compared the results of radiofrequency neurectomy (RFN) for facet joint pain in litigants and nonlitigants, both groups did equally well.

In 1956, Gotten reported that, of the 100 patients from an initial group of 212 patients with neck pain following whiplash whom he was able to locate years later, 88% improved after settlement. However, this study had only 40% follow-up and reported a high prevalence of chronic pain, despite litigation settlements. In 1961, Miller concluded that whiplash-associated disorders in litigant patients was caused by “accident neurosis” and implied that patients are “cured by verdict,” despite lacking data to support this conclusion.

Several studies have shown correlation between retaining an attorney and longer time to claim closure. Consulting a lawyer was associated with a lesser chance of early claim settlement, longer treatment, and slightly worse function, but not with improvement in pain or return to work at 12 months. In a no-fault, no-tort system, there is a shorter time to case closure. However, some feel that time to case closure cannot be equated to improvements in pain and disability.
Clinical Symptoms

Acute Versus Chronic Whiplash Pain

Acute neck pain occurs soon after injury. Chronic pain is defined not by an arbitrary determination of time but as pain that persists beyond the expected resolution of the structural injury. Because most patients with whiplash have recovered by 3 to 6 months, it is appropriate to define chronic whiplash as neck pain that persists beyond 6 months.

Neck Pain

Neck pain is the predominant symptom of whiplash injury. It may be midline or occur on either side or both sides. Pain is commonly referred to the trapezius muscle, shoulder, interscapular area, or arm, and occasionally to the face.

Arm Pain

Arm pain is common in chronic whiplash although, in the absence of neural compression, neck pain usually is more severe. Arm pain may be caused by radiculopathy as a result of neural compression from disk herniation or from preexisting foraminal stenosis rendered symptomatic by the trauma. In true radiculopathy, arm pain follows a dermatomal distribution, and there is objective neurologic deficit. More often, however, no objective neurologic deficit exists, despite arm pain caused by neural compression. By definition, this is not true radiculopathy; it might better be termed radicular pain. A lesion, such as lateral disk herniation or spinal stenosis of the lateral canal, is generally visible on magnetic resonance imaging (MRI). In the absence of neural compression, pain may be referred to the arm from a discogenic source (eg, painful disrupted disk, midline herniation) or, less commonly, from a facet joint.

Other sources of arm pain include shoulder pathology, ulnar nerve injury and/or entrapment at the elbow, and conditions unrelated to the neck (eg, brachial plexus lesion). Pain in the shoulder may be referred from the neck or caused by a primary shoulder problem.33,35,36 Facet joint–mediated arm pain is usually in the shoulder or uppermost arm.33,34 In a retrospective review of 34 patients with chronic neck pain located near the superomedial aspect of the scapula, Gorski and Schwartz35 found that 24 patients (71%) had been in a prior MVC. All patients had restriction of cervical range of motion, a positive impingement sign, pain relief after subacromial injection with local anesthetic and corticosteroid injection, and abnormal shoulder radiographs. Chauhan et al36 described a 22% prevalence of shoulder problems, most commonly impingement syndrome, in 524 patients with chronic whiplash injury. Carpal tunnel syndrome has been associated with shoulder and arm pain after whiplash.37 Ames37 postulated that such injury is the result of blunt trauma to the median nerve (ie, median neuropathy) from the steering wheel or dashboard rather than being true carpal tunnel syndrome.

Headache

Headache is the second most common symptom of whiplash. Cervicogenic headache, which may vary in severity and frequency, may be confused with migraine or tension-type headache. Cervicogenic headache almost always involves the base of the skull and frequently radiates to the crown of the head and frontal regions. It is often unilateral, and the side may vary in the same patient. This type of headache is often precipitated by prolonged static neck positions or repeated end-range flexion, extension, or axial rotation. There are several documented sources for chronic cervicogenic headache, including discogenic pain from C2-C3 and C3-C4, upper cervical disk herniation, an upper cervical facet joint, and the atlanto-occipital joint.38-40

Whiplash-Associated Disorders

Other symptoms associated with whiplash are referred to as whiplash-associated disorders. They include low back pain (LBP), visual disturbances, dizziness, tinnitus, weakness, fatigue, poor concentration or poor memory, difficulty sleeping, and secondary psychological changes (eg, depression).41-43

Low Back Pain

Cassidy et al42 stated, “Low back pain is a common traffic injury with a prolonged recovery.” Of 8,124 whiplash claimants, 4,473 initially had LBP. It was still present at 6 months in 30% to 42% of patients. Berglund et al44 noted a 20% prevalence of chronic LBP 7 years after MVC. Barnsley et al45 reported an approximate 40% prevalence of chronic LBP. The structural causes of LBP after MVC have not been studied specifically, but they do not appear to be different from the usual causes of chronic LBP. Sacroiliac joint pain, facet joint pain, and discogenic pain can occur after MVC trauma.44

Psychological Disorders

Peebles et al45 compared psychological findings in patients with chronic whiplash with those in patients who had other chronic musculoskeletal pain. The authors found no differences with respect to the prevalence or types of psychological problems. They reported no characteristic psychological whiplash profile. Mayou et al46 followed a group of patients for 1 year following MVC to evaluate early and late psychological consequences. Initially, almost 20% of patients suffered acute stress syndrome. At 1-year follow-up, 5% of patients met criteria for posttraumatic stress disorder, 18% had travel anxiety, and 12% had a mood disorder.

Psychological disorders secondary to pain and impairment would be expected to improve when pain is effec-
tively treated. RFN was used to treat 17 patients with both cervical facet joint pain and psychological abnormalities. All of the patients whose pain improved after RFN showed improvement in previously abnormal psychological tests scores. In all but one of those who did not improve after RFN, the psychological abnormalities did not change. Furthermore, when pain recurred, psychological abnormalities soon followed. When pain responded again to RFN, psychological tests improved once again.

Fear avoidance, in which patients avoid activities because they are fearful of those activities, is a psychological problem that is important in creating or perpetuating impairments. Common fears include fear in creating or perpetuating impairment. The patient will not cause further damage to himself or herself. Fear avoidance that persistent pain is an indicator of more serious pathology. In some instances, patient function decreases after the patient is reassured by the physician that it is fine to be active despite pain and that the patient will not cause further damage to himself or herself.

**Structural Etiology of Chronic Neck Pain Caused by Whiplash**

There are no findings on history or physical examination that are specific to any one structural cause of chronic axial neck pain. However, the history and physical examination are extremely important in excluding serious medical problems or causes of pain other than neck pain. The history provides information regarding the mechanism of injury, severity of pain, degree of impairment, and patient values, all of which contribute to evaluation and treatment.

The facet joints are the most common source of chronic neck pain after whiplash injury. Some patients have pain that arises from a disk, and some have a combination of facet joint pain and discogenic pain. The patient with acute whiplash may have pain secondary to injury to muscles and ligaments. However, as in most soft-tissue injuries, muscle and ligament injury heals in 6 to 8 weeks. There is no evidence that chronic neck pain is the result of whiplash affecting a chronically strained muscle or a chronically strained ligament.

**Facet Joints**

Biomechanical and autopsy studies indicate that the facet joints can be damaged in MVC. Clinical prospective studies provide level I evidence that the facet joints are the most common source of chronic pain resulting from whiplash injury. Chronic neck pain can be traced to a facet joint in 49% to 54% of patients with whiplash injury who have neck pain only and in 60% of those with both neck pain and headache. In patients with cervicogenic headache following whiplash injury, there is a 53% prevalence of C2-C3 facet joint pain.

Facet joint pain can be diagnosed only by anesthetizing the putative painful joint. Cervical facet joints are innervated by the medial branches of the cervical dorsal rami. A single block is not definitive because of the high false-positive rate. The diagnosis is made when pain is relieved on two separate occasions after the joint has been anesthetized by anesthetic injection of the medial branches of the cervical dorsal rami serving the putative painful facet joint (ie, medial branch block).

**Discogenic Pain**

The data implicating the disk as a source of chronic neck pain after whiplash are not as clear as those implicating the facet joints. Anatomic, biomechanical, and autopsy studies indicate that the intervertebral disks are innervated and that disks can be injured during whiplash. In addition, uncontrolled clinical studies are consistent with observations in healthy volunteers that cervical disks are a potential source of pain and that anterior cervical disectomy and fusion (ACDF) relieves pain in approximately 70% of well-selected patients.

Diskography has been used to identify painful cervical disks. This may be a useful test when strict protocols are observed and the results are interpreted in conjunction with the other clinical information. Diskography should be reserved for the patient with refractory pain who is being considered for surgery; it should not be used simply to establish the diagnosis. Diskography may reveal multiple painful disks and thus eliminate surgery as a consideration.

There is some evidence that cervical disk injection may precipitate pain from a facet joint and that some patients may have both disk and facet joint pain. To maximize the chances of a true-positive diskogram, a medial branch block at the index level should be performed before diskography and be negative. In addition, injections of disks adjacent to the painful disk or disks should be painless.

**Cranio cervical Ligaments**

Radiographic studies provide evidence that alar and transverse ligaments may be damaged in whiplash. A series of MRI studies demonstrated that ligamentous injury was more common in patients with a history of whiplash than in asymptomatic individuals. These studies did not correlate imaging findings with patient symptoms.

When these lesions are indeed symptomatic, their location at the C1 level might render them a potential source of cervicogenic headache but not necessarily of neck pain. However, these ligamentous injuries were not found in cervical spine specimens subjected to low-impact simulation.
Other Soft-tissue Injury

Soft-tissue injury may be the most controversial and misunderstood clinical aspect of whiplash injury. This is partly because soft-tissue injury is a nonspecific and potentially confusing term that has little clinical value. Soft-tissue injury implies only that some part of the cervical support structures other than bone has been injured. Using this definition, injury to cartilage, facet joints, and disks all would be considered soft-tissue injury. There is no evidence that neck pain that has lasted for >3 to 4 months can be attributed to chronic strain or sprain, although these terms are used frequently, especially in the medicolegal context. Furthermore, no studies adequately demonstrate that damage to the soft tissues alone is a primary cause of moderate to severe chronic neck pain. Muscles may become sore from chronic poor posture; however, this pain is usually described as a mild to moderate ache and is not sufficiently severe to cause meaningful impairment.

Treatment

Acute Neck Pain

Once serious injury is ruled out by clinical examination and, if necessary, cervical radiographs, initial treatment should consist of explanation, education, and reassurance. In the absence of significant neurologic abnormalities or suspicion of fracture, advanced imaging studies usually are not necessary for at least 3 months. The physician should recommend that the patient remain active, despite pain, and explain the generally favorable natural history. This cannot be overemphasized. It is not clear that any early intervention can prevent chronic symptoms. Kongsted et al performed a prospective randomized study comparing the outcomes at 1 year for acute whiplash patients treated with immobilization in a cervical orthosis, active mobilization using range-of-motion exercises, or recommendations to “act as usual.” At 1 year, there were no significant differences observed among the groups except for a higher rate of disability in the cervical orthosis group. At 1 year overall, 48% of the patients reported considerable neck pain, 53% had some degree of disability, and 14% were still off work.

That said, it appears that patients who remain active despite pain generally have a more favorable outcome than do those who rest excessively or avoid activity. Exercises should be prescribed rather than just suggested. It is not usually necessary to refer a patient to a physical therapist in the acute stage. There are many informational booklets and books available. The evidence regarding spinal manipulative therapy (SMT) is conflicting. Several reviews have found no evidence that SMT is useful when used alone or in conjunction with passive modalities. However, Hoving et al reported slightly better outcomes when SMT was combined with exercise.

Vassiliou et al compared the outcomes at 6 weeks and 6 months in a randomized trial that compared cervical orthosis with 10 physical therapy visits. The authors concluded that physical therapy that includes active exercise is superior to treatment with a soft collar. However, at the same time, it must be noted that patients who utilized more health care in the first 30 days after injury had slower recovery than did those who used less care.

Chronic Neck Pain

Rehabilitation

Physical therapy is usually the first treatment prescribed for the patient with chronic neck pain. Effective rehabilitation requires strengthening exercises and training in body mechanics. Modalities and stretching are often used, as well, despite little or no evidence of efficacy. Exercise alone is rarely curative. On average, studies report between 25% to 75% reduction in pain. The best available evidence supports exercise as effective treatment for chronic neck pain, but there is just one study that is specific for patients with neck pain resulting from whiplash. The authors compared patients treated with advice alone to those treated with advice plus 12 sessions of exercise over 6 weeks. Exercise plus advice produced somewhat superior results, with small improvements in pain intensity and bothersomeness, disability, and quality of life after 6 weeks. However, the benefits were not apparent at 12 months. Patients with higher levels of pain and disability improved to a greater extent.

There do not appear to be meaningful differences between whiplash patients and others with chronic neck pain. Therefore, the outcome data of rehabilitation for chronic neck pain should be applicable to whiplash patients.

There is fair evidence that exercise directed toward strengthening the neck and shoulder-thoracic area can reduce pain and improve function in the patient with chronic neck pain. The patient must continue to exercise to maintain these gains. Strength training and endurance training both have been shown to be better than stretching and aerobic training. Intensive exercises are more effective than light exercises but not necessarily more effective than ordinary activity. There is moderate evidence that a multidisciplinary program can reduce pain, improve range of motion, improve function, and decrease disability compared with placebo therapy.

Rehabilitation prescriptions must be specific and directed toward strengthening the muscles that are usually weak—the anterior muscle group, the interscapular muscles, and the posterior neck muscles. Also, there must be a specific prescription for body mechanics training for activities of daily living, with special attention given to work and...
recreational ergonomics. In addition, good rehabilitation indirectly provides behavior modification to help overcome fear avoidance with respect to activities of daily living and exercise without supervision.

**Injections**

Level I evidence supports the efficacy of RFN as a treatment for chronic neck pain that arises from facet joints.⁷⁷,⁷⁸ RFN is appropriate only for the patient with proven facet joint pain. RFN is the coagulation of the medial branches of the dorsal rami that are responsible for conducting pain from the joint. The indication for RFN is significant pain relief following controlled anesthetic blocks of the medial branches of the nerve supply to a specific facet joint. Complete pain relief can be achieved in many patients with pure facet joint pain and in 86% of patients with facet joint–mediated cervicogenic headache.⁷⁷–⁷⁹ Other patients will experience ≥50% relief, which is sufficient to make a meaningful difference in function and quality of life. Some of these patients may have other pain generators in addition to the facet joints. Relief lasts a median of 270 to 400 days, after which pain recurs because the nerves regenerate. Repeat RFN is usually effective in relieving recurrent pain.⁷⁸ Intra-articular injections of corticosteroids do not provide long-term relief; however, they may provide short-term relief, during which rehabilitation may be more easily performed. There are no data to support the use of trigger point injection.

There is no evidence to suggest that cervical epidural corticosteroid injection is effective in relieving axial neck pain. The data for radicular pain are mixed.⁸⁰–⁸² At best, 30% of patients have partial but long-lasting relief and another 30% have complete relief with transformaminal injection.⁸⁰–⁸² However, it has been suggested that cervical epidural corticosteroid injections are not useful for traumatically induced radicular pain.⁸²

**Case Example**

A 46-year-old man was the fully restrained driver of a car struck from the rear by a sport utility vehicle moving at 25 mph. The patient had immediate neck pain, which persisted for 9 months and significantly interfered with his quality of life. Pain was located in the right side of his neck at C5-C6 and radiated to the right trapezius and proximal interscapular region. Physical examination revealed only guarded range of motion. MRI showed a very small midline disk herniation at C5-C6. The patient failed to improve despite physical therapy, medication, and epidural corticosteroid injection. Medial branch blocks were performed to denervate C5-C6 and C6-C7. After the local anesthetic phase, the patient experienced 80% relief of pain for 3 to 4 hours. A second injection 2 weeks later yielded the same results. RFN was performed to denervate these two levels. The patient was worse for 1 week, then was markedly improved. Symptoms recurred at 11 months. A repeat RFN was performed and was equally successful in providing pain relief.

**Medication**

Medication may play a role in the treatment of neck pain after an MVC.⁸³ For the patient with acute neck pain, the most useful drugs are nonsteroidal anti-inflammatory drugs (NSAIDs), opioid analgesics, and muscle relaxants (which may be useful for up to 14 days after the accident).⁸³ The response to NSAIDs for treating chronic neck pain is unpredictable. It is appropriate to try several NSAIDs for up to 2 weeks each in patients with low risk for systemic side effects. When there is a meaningful response, the drug should be continued; when there is no response to three trials of different NSAIDs, further NSAID trials are not likely to be helpful.

Opioid analgesics can play a valuable role in well-selected patients with chronic, moderate to severe neck pain that has proved to be refractory to other treatments. Although there are no data specific for treating chronic neck pain, opioids have proved to be valuable in the treatment of LBP and other chronic musculoskeletal conditions. Tricyclic antidepressants (eg, nortriptyline) have been shown to be useful in chronic axial LBP, but there are no data specific to chronic neck pain. Anticonvulsants (eg, gabapentin, pregabalin, topiramate) may be helpful in neuropathic pain but rarely provide benefit to the patient with axial neck pain.

**Spinal Manipulative Therapy**

Although there is no consensus about the efficacy of SMT for chronic neck pain, it remains one of the most popular treatments.⁶⁴,⁶⁵ When SMT alone was compared with exercise alone and exercise plus SMT, both exercise groups did somewhat better than did the group with SMT alone, although all treatment groups improved. However, when intensive training, physiotherapy, and SMT were compared, there were no differences between groups, and all groups improved. Although there are anecdotes about serious complications from SMT, the incidence is quite low.

**Cervical Orthoses**

Cervical orthoses are of no value in the patient with acute whiplash injury. Persson et al⁸⁴ compared three groups of patients with long-lasting radiculopathy who were treated with surgery, physical therapy, or a cervical collar. No significant clinical or statistical differences were found between groups at 12-month follow-up; all groups did reasonably well. However, these results are blurred by a high number of patients who crossed over between groups.

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Surgery

There is controversy regarding the role of surgery for the patient with axial neck pain. Garvey et al\textsuperscript{54} reported on 87 patients, including 25 with chronic whiplash injury, who underwent ACDF for axial neck pain. At 4-year follow-up, 83\% of patients had good to excellent results and statistically significant improvements in both the Oswestry Disability Index and the modified Roland Morris Disability Questionnaire. Palit et al\textsuperscript{55} reported on 38 patients who underwent ACDF for axial neck pain. The authors noted significant improvement in pain and Oswestry Disability Index score; 79\% of patients were satisfied with their outcomes. Similar findings were reported for ACDF at C2-C3 and C3-C4 for discogenic cervical headaches in a study with nine patients.\textsuperscript{38}

Surgery may be considered for the patient with severe pain, significant impairment, and good psychological health who has not improved sufficiently with high-quality nonsurgical care. The surgeon should order plain radiographs with flexion and extension views (to screen for instability and evaluate levels adjacent to the index level for degenerative changes) and MRI. Although somewhat controversial, diskography might be considered. Diskography can be useful when it is interpreted in the context of the history, physical examination, and other tests. To interpret diskography, the following two conditions must be met: (1) no significant pain relief after a medial branch block, combined with disk injection demonstrating concordant pain reproduction at the index level or levels, and (2) no pain at adjacent levels. In the patient requiring surgery for axial neck pain, better overall surgical results were achieved when diskography was included in the preoperative evaluation than when it was not used.\textsuperscript{85} Because ACDF eliminates motion at the painful segment, theoretically, if there were both a painful disk and facet joint, ACDF would treat both.

Case Example

A 39-year-old woman with no preexisting history of neck pain was injured in a rear-end MVC. When seen 1 year after the accident, she had predominant axial neck pain and restricted range of motion. The neurologic examination was normal. She did not respond to treatments that included physical therapy, medications, and medial branch blocks. Plain radiographs showed mild degenerative changes at C5-6 and reversal of the cervical lordosis [Figure 2]. MRI showed a disk herniation at C5-6 [Figure 3]. Diskography was positive (ie, concordant pain) at C5-6 and negative at adjacent levels. The

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**Figure 2**

Lateral radiograph of the cervical spine in a 39-year-old woman showing mild disk degenerative changes at C5-6 and reversal of the cervical lordosis.

**Figure 3**

Same patient as in Figure 2. Sagittal MRI scan showing narrow disk with mild dessication and small herniation at C5-6.
patient underwent ACDF with allograft bone and plate fixation at C5-C6. Her cervical pain and headaches resolved by 2 months postoperatively, and the patient returned to full activity at 3 months. Her fusion healed without complication.

Summary

For the patient with chronic neck pain caused by whiplash, a careful history and examination are necessary to establish or exclude neurologic deficits, nonspinal musculoskeletal causes of pain, and systemic illness. The most likely sources of mechanical neck pain are facet joints, intervertebral disks, or both. The patient should be referred for physical therapy to strengthen the neck and upper back muscles, learn body mechanics and ergonomics, and overcome fear-based avoidance of activity.

When there is no meaningful improvement with physical therapy, the facet joints should be investigated by medial branch blocks. The levels tested are selected based on the location and referral patterns of the pain, the location of tenderness on physical examination, and the location of any abnormal segments on MRI or plain radiographs.

If medial branch blocks provide significant relief of pain on two separate occasions, RFN should be considered. When medial branch blocks determine that the facets are not pain generators, and pain is severe, the disks are the most likely pain generator, and surgery may be an option. When surgery is not an option, long-term medical management, often involving opioid analgesics, may be considered.

References

Evidence-based Medicine: There are 25 level I/II studies: 12 prospective randomized controlled trials [references 60-62, 65, 66, 68, 69, 72-74, 77, and 84], 9 prospective prognostic studies [references 3, 18, 21, 23, 28, 42, 44, 48, and 71], and 4 systematic reviews of randomized controlled trials [references 14, 15, 64, and 70]. There are 12 biomechanical or anatomic studies. The remaining references are level III/IV (observational studies, case-control reports, or cohort studies) or level V (expert opinion).

Citation numbers printed in bold indicate references published within the past 5 years.


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