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PAIN PRACTICE SOLUTIONS

The impact of pre-existing conditions on the risk and severity of Whiplash Associated Disorders

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Purpose Statement

This white paper provides an in-depth review of how pre-existing conditions, including physical and mental health disorders, affect the development, severity, and recovery of Whiplash-Associated Disorder (WAD). It is intended to guide healthcare providers and legal professionals in understanding the prognostic implications of these conditions in WAD patients.

Executive Summary

Discogenic pathology often underlies more complex cases of WAD. Early intervention with epidural injections can reduce pain and neural inflammation, lower the likelihood of surgical intervention, and help prevent central sensitization and psychological complications linked to poor outcomes. Emerging evidence indicates disc injury may be more common in WAD than previously thought, and timely treatment by trained providers can enhance pain control and quality of life.

Key Findings

- **Degenerative disc disease (DDD)**, whether age-related or post-traumatic—reduces the spine's ability to absorb forces and distribute loads effectively at the affected segment.
- **Facet joint degeneration** impairs load distribution and spinal stability. Asymmetric degeneration (facet tropism) can lead to instability in adjacent segments.
- **Prior injuries**, even if asymptomatic before trauma, increase susceptibility to future injuries in the same region.
- **Older age at the time of trauma** lowers the threshold of force needed to cause injury due to reduced tissue resilience.
- **Pre-existing headache disorders** raise the risk of persistent or worsening headaches following WAD.
- **History of concussion** increases vulnerability to future head injuries, often resulting in worsened post-traumatic symptoms such as cognitive dysfunction and higher risk of musculoskeletal injury.
- **Herniated discs** may act as pain generators, and their symptomatic sites can sometimes go undetected on standard MRI scans.
- **Congenital spinal conditions**, such as ankylosing spondylitis or scoliosis, elevate the risk of fractures and chronic pain after motor vehicle accidents.
- **Mental health disorders**, including anxiety and depression, are closely linked to poorer WAD outcomes and are associated with central nervous system hypersensitivity.

Implications

Pre-existing conditions can significantly impact both the clinical presentation and recovery trajectory following a motor vehicle accident (MVA). Healthcare and legal professionals should evaluate these conditions early in the recovery process to guide effective treatment and case management.

Introduction

Whiplash-Associated Disorder (WAD) involves multiple systems in the neck, head, face, and arms, often resulting in pain, limited motion, peripheral nerve dysfunction, and central nervous system involvement. [1-4] For a comprehensive overview, refer to the white paper titled “Whiplash: An In-Depth Review of Pathology and the Biomechanics of Injury” published by this organization. WAD is increasingly prevalent in the U.S. and globally, [5-7] with associated costs reaching billions due to healthcare expenses and lost productivity. [8-10] While much of the research focuses on pain and functional loss, growing attention is being given to the influence of pre-existing conditions on WAD outcomes for both clinical and medico-legal purposes. [11]

Overview of Pre-Existing Conditions That Influence WAD

While joint and soft tissue injuries can heal, they rarely return to their original structural integrity. [12-15] Pre-existing conditions, such as joint or disc degeneration, prior concussions, chronic headaches, or previous neck injuries, can be aggravated by a Whiplash-Associated Disorder (WAD). Additionally, age-related spinal changes and pre-injury mental health conditions can significantly affect recovery outcomes following a motor vehicle accident (MVA). The following sections explore how these pre-existing factors influence WAD severity and prognosis.

Specific Pre-Existing Conditions Affecting WAD Risk and Severity

Numerous pre-existing conditions have been shown to increase the risk and severity of Whiplash-Associated Disorders (WAD) following a motor vehicle accident (MVA). These conditions often compromise the structural integrity, neuromuscular coordination, or neuropsychological resilience of the individual, leading to poorer outcomes in terms of pain, disability, and recovery trajectory.

Previous Cervical Spine Injuries

Research has shown that prior injuries to a specific body region often led to degenerative changes and increased risk of future dysfunction. Greene et al. found that athletes with a history of low back pain were three times more likely to experience reinjury. [16] Similarly, injuries to the hamstrings, Achilles tendon, ACL, and ankle ligaments are predictive of future injury in active adults. [17] Prior shoulder dislocations have also been linked to increased risk of joint laxity and arthritis. [18,19]

Of particular relevance to this paper, studies on the cervical spine demonstrate that previous neck injuries are associated with increased risk of pain, poorer prognosis, and functional loss.[20–24] One study involving 7,669 adults identified prior neck trauma as a significant predictor of future neck pain.[22] Another study reported that spinal fusion can disrupt cervical mobility, increasing shear forces at adjacent levels and causing degeneration in nearly half of cases.[25]

Whiplash injuries involving a cervical spine with pre-existing degenerative changes may result in increased axial and rotational movement, leading to more severe articular and capsular damage compared to a healthy spine. The literature suggests that in such cases, whiplash may act as a catalyst for the onset of WAD symptoms and increase the likelihood of nonrecovery. [26]

Nee echoed this concern in 2008, stating that "the best available evidence suggests that a previous injury with incomplete recovery represents an adverse prognostic indicator."[27] These unresolved injuries can alter movement patterns and establish a maladaptive, compensatory state—functional only until the patient exceeds their individual tolerance threshold.[28–34] When new trauma occurs, previously injured tissues face mechanical demands they are no longer capable of absorbing.[35,36] As a result, reinjury becomes more likely due to impaired load distribution and nervous system maladaptations.[17,37–39]

This relationship between prior injury and poor recovery is well supported. Studies have shown that individuals with a history of tissue damage experience slower, more complicated healing. [40–42] A large systematic review also confirmed that whiplash trauma is linked to future neck pain.[24]

Age further compounds this risk. As spinal tissues naturally degenerate over time, they lose structural integrity, making older individuals more vulnerable to injury and delayed recovery.[43–45] Yoganandan et al. found that the force required to cause cervical injury decreases with age.[46] Salcido noted that aging spines lose height and flexibility, contributing to instability, and concluded that “persons with advanced age and pre-existing conditions are at risk for mild to moderate instability of the spine.”[47] Additionally, pre-existing spinal abnormalities in older adults significantly increase the risk of catastrophic cervical spinal cord injury.[48]

Degenerative Disc Disease

Degenerative disc disease (DDD) may not always cause pain initially, but it significantly impairs the spine's ability to tolerate mechanical loads.[49] Disc degeneration leads to gradual height loss, resulting in laxity of the surrounding soft tissues and buckling of supporting ligaments.[50] These changes often produce disc bulges and increase loading on the facet joints, which are among the most frequently injured structures in WAD.[39,50,51] Additionally, these biomechanical disruptions cause force redistribution to adjacent segments, reducing their load tolerance and promoting adjacent segment instability.[50–52]

Degenerated discs have reduced resistance not only to compressive loads but also to eccentric forces such as flexion, lateral flexion, and rotation. [50,53] This is significant because intervertebral discs provide the spine's primary resistance to small external forces. [52] When degenerative discs are accompanied by dysfunctional paraspinal muscles from prior injury, overall spinal stability is further compromised. [52]

These structural changes have been linked to poorer recovery outcomes after whiplash trauma. [54,55] This connection is supported by anatomical research, which shows that progressive disc breakdown weakens the tissue and increases susceptibility to further injury. [56–58] In vivo studies also demonstrate that torsional loading increases as degeneration progresses, particularly due to expansion of the neutral zone, further elevating injury risk. [58]

Degenerative Joint Disease (Facets)

Degenerative joint disease (DJD) of the cervical facet joints involves age- or trauma-related changes to the articular cartilage, synovium, and joint capsule. These changes include cartilage thinning, synovial cyst formation, fibrocartilage proliferation, and osteophyte development, all characteristic of facet joint degeneration. [59]

This degeneration can sensitize the medial branches of the dorsal rami, leading to referred pain in the neck, upper extremities, and even the head.[60] Importantly, facet degeneration may occur independently of disc degeneration and can significantly impair cervical spine mobility.[51,57,61,62] It typically reduces motion at the affected segment while increasing motion in adjacent segments, resulting in joint laxity and spinal instability.[51] Over time, this imbalance may promote osteophyte formation.[63]

Facet joint degeneration is a known risk factor for poor recovery following whiplash trauma.[54] Structural changes to the facet joint have been shown to reduce tensile and shear strength, making the joint more susceptible to injury.[64] Additionally, facet tropism—an asymmetry in facet joint orientation between the left and right sides, can amplify stress on neighboring discs and joints, increasing the risk of disc herniation and accelerating joint degeneration.[65–67]

Headaches and Concussions

Individuals with a history of headaches may experience more difficulty recovering from whiplash, as symptoms often worsen or persist following trauma. [68–70] The same trend is observed in patients with a history of concussion. Studies show that prior concussions increase the risk of prolonged post-injury symptoms such as headache, neurocognitive impairment, and depression. [71–75] Additionally, individuals with multiple past concussions face a heightened risk of subsequent lower extremity injuries. [76]

Herniated Discs

Herniated discs often occur without symptoms.[77] However, Fujimura et al. found that posterior disc protrusions were more common in WAD patients than in control groups.[78] A previously injured disc may be more likely to become symptomatic following a whiplash injury than some studies suggest.[79–81] Taylor and Twomey noted that while MRI may reveal traumatic disc herniations, it can miss disc avulsions and zygapophyseal joint lesions, especially in well-aligned spines.[82] Long-term studies have confirmed that intervertebral discs can act as pain generators, even two years post-injury.[83] Thoracic disc herniations, previously asymptomatic, have also been linked to severe upper back pain after whiplash trauma.[84]

From a biomechanical standpoint, rear-end collisions (the most common type of MVA) generate shear, extension, and compression forces. These forces can lead to nucleus cracks, annular fiber strain, and vertebral endplate avulsions. [85–89] When there is a history of cervical disc injury and radiculopathic pain, the nervous system may become hypersensitized. [90–93] In such cases, neural structures, including those innervating the disc—can become sensitized, increasing the likelihood of discogenic pain after a new injury.

Ankylosing Spondylitis

Ankylosing spondylitis (AS) is a chronic inflammatory condition characterized by back pain, asymmetrical arthritis (particularly in the lower limbs), enthesitis, and osteoproliferation leading to spinal stiffness, decreased mobility, or ankylosis (fusion of spinal bones). [94] AS also carries a heightened risk of fractures and low bone density. Ebrahimiadib et al. reported that fractures can occur "even with trivial trauma." [95]

AS presents a significant risk factor in the context of motor vehicle accidents (MVAs). Patients with pre-existing AS often experience severe post-traumatic pain, instability, and poor recovery outcomes. One study found a 50% failure rate of surgical stabilization in AS patients due to brittle bone structure.[96] Post-MVA mortality rates are also higher in this population.[96] Notably, even low-speed collisions have been associated with fractures, cervical spine instability, spinal cord compression, and epidural hematomas in individuals with AS, some with fatal outcomes.[97–99]

In addition, trauma may trigger underlying genetic predispositions. Urano et al. observed a significant number of patients who developed axial spondyloarthritis (AxSpA) following a whiplash event. Their study concluded that "trauma may influence the course of AxSpA through the immunological system or hypothalamic-pituitary-adrenal axis." [100]

Congenital Spine Disorders

Congenital spinal disorders, such as idiopathic scoliosis (IS), can cause chronic pain and increase the risk of injury, even in the absence of trauma. [101] Patients with IS often experience persistent discomfort that worsens with greater curvature severity. One study involving 20,566 patients found that individuals with spinal curvature had a 2.2 times higher risk of injury, including fractures, dislocations, nerve damage, and contusions, compared to controls. [102]

Another complicating factor is impaired pain modulation, which is common in individuals with IS.[103] This predisposition can amplify the pain experience after trauma, making whiplash injuries more symptomatic and potentially leading to poorer recovery outcomes. Additionally, chronic pain in IS patients increases the risk of developing depression or anxiety, conditions that are independently associated with unfavorable post-MVA recovery. [104–108] This population, therefore, requires specialized care and early intervention to optimize recovery following a whiplash event.

Influence of Psychological and Systemic Factors

Patients with a history of mental health conditions such as anxiety or depression tend to have poorer outcomes following whiplash injury.[109,110] Pre-existing anxiety or depression is linked to persistent depressive symptoms in both WAD and other spinal injuries.[44,111] Notably, up to 40% of patients report depressive symptoms early in WAD recovery, with around 20% continuing to experience them long-term.[112] Among those with chronic WAD, 58% developed a psychiatric disorder, and even in patients who physically recovered, 29% still presented with psychiatric symptoms.[113] High levels of pain-related catastrophic thinking prior to injury have also been shown to significantly worsen prognosis.[114]

Patients with mental health comorbidities often report higher pain levels than those without. Symptoms such as avoidance, negative thinking, heightened physiological arousal, and hypervigilance (constant focus on pain) can amplify the pain experience. [115,116] Pain perception is further influenced by central nervous system neurotransmitters like serotonin and norepinephrine, both of which are often dysregulated in individuals with mood disorders. [117]

Research shows that mental health disorders frequently co-occur with central sensitization, a phenomenon in which pain signals are amplified. [118–121] Recognizing and addressing both psychological and neurological components is crucial to optimizing recovery after whiplash.

Implications for Clinical Practice and Treatment

Whiplash-Associated Disorder (WAD) is a multifaceted condition involving numerous potential pain generators, each contributing to its complex presentation. When a patient has a pre-existing condition, whether musculoskeletal, neurological, or psychological, these factors can further complicate the clinical picture and delay recovery. Structural spinal conditions may impair force distribution during trauma, resulting in greater tissue stress and exaggerated symptoms.

Similarly, mental health disorders present before the motor vehicle accident (MVA), or those that develop afterward, can adversely affect pain perception and recovery trajectory. Therefore, early recognition of these complicating variables is essential for effective clinical management.

Timely triage and referrals are key. Healthcare teams should use tools like the Neck Disability Index (NDI) and the Central Sensitization Inventory (CSI) in the early phases to help assess prognosis and direct appropriate resources.[114,120,122,123] Patient-reported sensitivity to cold or mechanical stimuli can also inform early-stage management decisions.[114,124] Educating patients and initiating early therapeutic movement (e.g., physical therapy) has been shown to promote recovery.[125,126] Complementary treatments like acupuncture or dry needling can help relieve pain and improve range of motion.[127]

A comprehensive physical exam—integrating radiographs, MRI, or diagnostic ultrasound—can uncover pathology not apparent through imaging alone. [93,128,129] Neurodynamic tests and nerve assessments may reveal intraneural inflammation, guiding more tailored treatments. [93] In later recovery phases, progressive exercise therapy and hands-on manual therapy have demonstrated efficacy in both symptom relief and functional restoration.[130–132]

Ultimately, success in treating WAD lies in the early implementation of secondary prevention strategies—aimed at promptly identifying acute or subacute pain and treating it before it becomes chronic. [133,134] One of the primary goals of this approach is to prevent central sensitization from developing, even if peripheral sensitization has already occurred. Research consistently shows that effective early pain management not only improves physical recovery but also reduces the psychological burden associated with poor WAD outcomes. [135,136]

Conclusion

Pre-existing conditions significantly influence both the clinical presentation and the recovery process in patients with Whiplash-Associated Disorder (WAD). These conditions can alter pain perception, healing timelines, and functional outcomes. It is critical that healthcare providers recognize and address the impact of such conditions early in the treatment process. A well-trained, multidisciplinary healthcare team is essential to ensuring patients receive individualized care that maximizes their potential for recovery.

Next Steps

For attorneys seeking the best outcomes for their clients, it is essential that the healthcare team involved in their care has a deep understanding of the principles outlined in this white paper. Pre-existing and comorbid conditions can significantly influence the clinical course and recovery of individuals with Whiplash-Associated Disorder (WAD). Recognizing and addressing these factors is crucial. Referring clients to providers who are experienced in managing these complexities can strengthen medical-legal documentation and ultimately support more favorable case resolutions.

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