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FINAL PAPER
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Cervicalgia in the Military Population:

Objectives:

1. The reader will be able to discuss the multiple etiologies of cervicalgia.
2. The reader will be able to explain appropriate evaluation tools for assessing a presentation of cervicalgia.
3. The reader will be able to describe appropriate interventions for the varying presentations of cervicalgia.
4. The reader will be able to rationalize the use of preventative care in the setting of cervicalgia.

Background & Epidemiology:

Musculoskeletal injury is a primary obstacle preventing optimal service member function, human performance, and force readiness within the military branches.[1] Beyond the effect of an individual's physical dysfunction, fiscal implications exist related to medical costs and manpower due to time-away from duty.[1,2] In Naval Special Warfare officers, neck and back pain has the highest prevalence of injury with high rates in other military branches, as well.[1] In a prevalence study conducted from 1980-2002, Leslie and his colleagues found that 15% of U.S. Army soldiers reported neck pain.[2] A thorough understanding of the nature of injuries and the best-practice for interventions for rehabilitating the injury is essential when working with the military population as history of injury such as neck pain can increase the chance of reporting re-injury by seven times.[3]

Within the civilian population, neck pain demonstrates an annual prevalence greater than 30%, representing the fourth leading cause of disability.[4] Of those individuals who report acute neck pain, 50% of subjects will experience continued pain to some degree with frequent recurrence.[4]

Multiple risk factors can predispose service members to reporting neck pain. In fighter pilots, neck pain is often correlated with physical positioning with airborne maneuvers and varying load associated with head gear.[5] Work-related factors are often associated with increased risk of neck pain, such as poor job satisfaction or high job demand, both of which are common complaints within the military.[6] Furthermore, positioning is also highly correlated with onset of neck pain, such as bending forward over a computer.[6] Many service members have occupational roles that have high physical demand but also require extensive desk work which both contribute to neck pain.[6,7] Physical therapists working with the military population need a thorough understanding of neck-related pain in order to properly diagnose mild to severe disorders with the ultimate goal to improve the individual service member's pain and function but also optimize force readiness.[8]

Anatomical Considerations:

When evaluating a service member for neck pain, the physical therapist should have a thorough understanding of anatomy in the head, neck, and surrounding joints as pain and function is intricately related.[9] Multiple bones are involved in movement within the neck, including the occiput and vertebral bodies (Figure 1[10]). When the therapist is evaluating the patient, bony relationships and alignments may indicate homeostatic or dysfunctional patterns. Two spinal curvatures are present within the cervical segments, with the upper cervical segment comprising C_0-C_2 and typically demonstrates a slight kyphotic curvature, while the lower cervical segment comprises C_3-C_7 and demonstrates a more apparent lordotic curvature. The majority of rotation comes from the interaction between the Atlas (C_1) and Axis (C_2). While not specifically a component of the cervical spine, the superior thoracic vertebrae (T_1-T_2) can often demonstrate

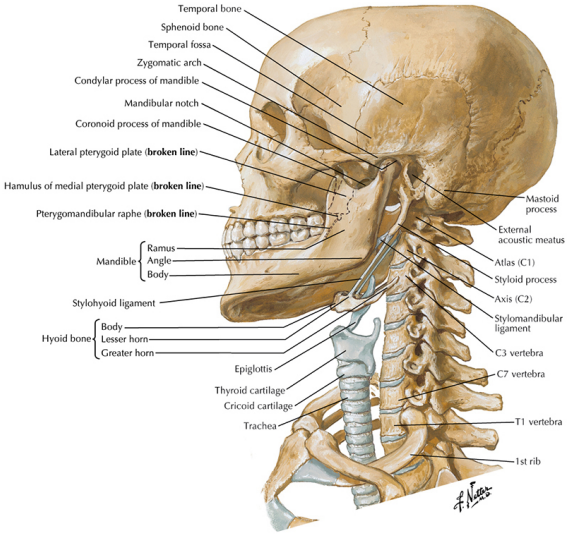

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FIGURE 1

abnormal mobility and sensitivity, with lower segments often being involved as well due to the role as a transitional point in the spinal column.

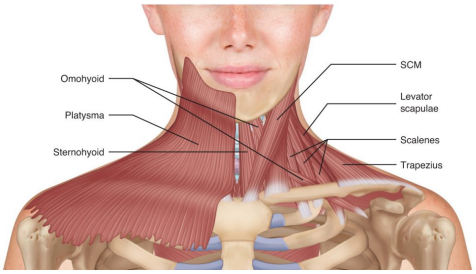

FIGURE 2

Neuromuscular systems can also impact the presentation of neck pain in the service member. The neck represents a complex relationship of agonist and antagonist muscles working to stabilize the head. Some muscles that might demonstrate dysfunction are the sternocleidomastoid, the deep neck flexors (longus colli and longus capitis), the anterior scalenes, the middle scalenes, and the posterior scalenes in the anterior portion of the neck (Figure 2[11]). The posterior musculature includes the upper trapezius, middle trapezius, and lower trapezius as well as the paraspinals, rhomboids, and the sub-occipital triangle (Figure 3[11]). The sub-occipital triangle is comprised of the inferior oblique, superior oblique, and the rectus capitis posterior major and minor muscles (Figure 4[12]). The relationship of the muscles to nerves in the area can also contribute to the service member's chief complaint. Vertebral nerves (C_1-C_8) exiting the neural foramina may contribute to radiculopathy seen in a dermatomal or myotomal pattern upon evaluation. The nerves may also be impinged by the scalenes along the brachial plexus, which can be seen in Thoracic Outlet Syndrome that might be provoked with special testing (Figure 5[11]). Furthermore, patients may report pain in the region of the sub-occipital triangle due to impingement from poor posture.

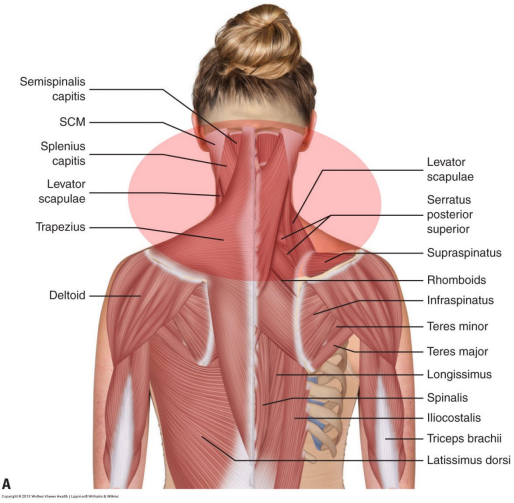

FIGURE 3

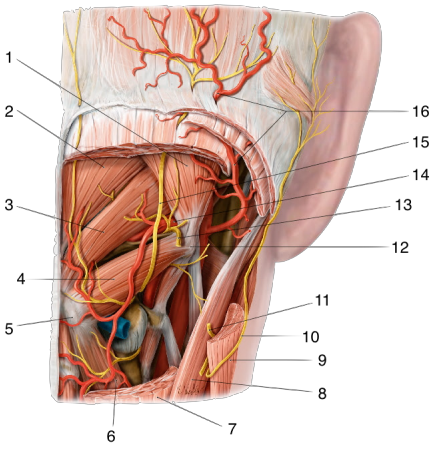

FIGURE 4

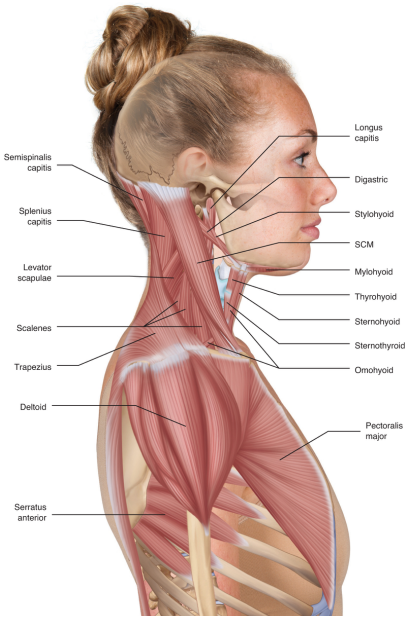

FIGURE 5

Causes:

Neck pain can be classified by duration, severity, etiology/structure, type, and mechanism.[4] Mechanisms can be broken down into neuropathic, mechanical, or secondary to another cause.[4] Mechanical neck pain is associated with pain

originating from the spine or supporting structures (i.e., muscles, ligaments, facets), with specific presentations including discogenic pain, myofascial pain, mechanical injury, and facet join pain.[4] Neuropathic pain is associated with pain referring from peripheral nervous system disease or injury, including cervical radiculopathy (from spinal stenosis, osteophyte impingement, or herniated disk) (Figure 6[13]), myelopathy (from spinal cord pathology) (Figure 7[8]), or disc degeneration (Figure 8[13]).[4] Neck pain could also be a referral pattern from systemic pathology, such as heart or vascular origin.[4] Within the military, physical therapists can see multiple diagnoses that might contribute to neck pain including concussion, cervicogenic headache, cervical radiculopathy, whiplash injury, muscle strain, trigger point referral, disc degeneration, and occupational/equipment overuse injuries.

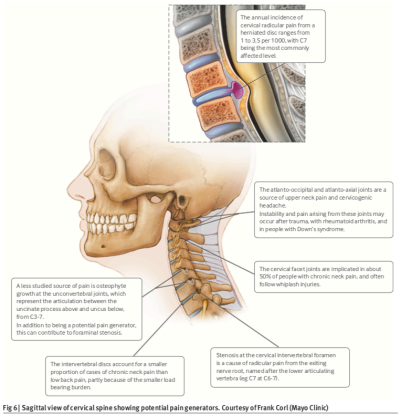

Fig 6| Sagittal view of cervical spine showing potential pain generators. Courtesy of Frank Corl (Mayo Clinic)

FIGURE 6

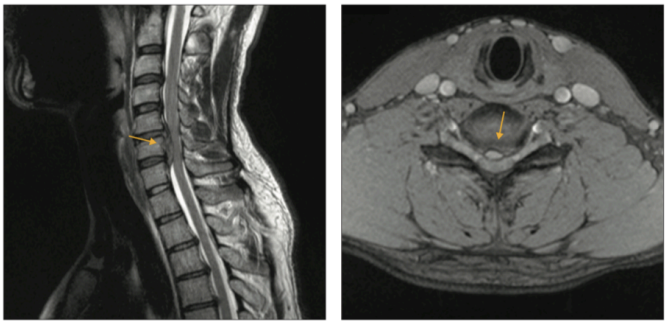
FIGURE 1. Sagittal T2-weighted magnetic resonance image demonstrating a large disc extrusion at C5-C6, which caused severe spinal canal stenosis and compression of the anterior cervical cord that extends to the C6-C7 level (arrow).

FIGURE 2. Axial T2-weighted magnetic resonance image demonstrating a large disc extrusion at C5-C6, which caused flattening and indentation of the anterior cervical cord (arrow).

FIGURE 7

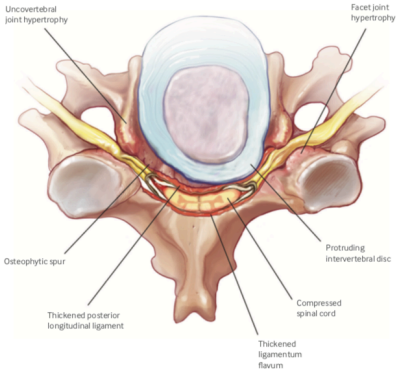

Fig 7| Axial view of the cervical spine showing potential causes of spinal stenosis. Courtesy of Frank Corl (Mayo Clinic)

FIGURE 8

Since 2000, Helmick reports that 300,000 service members have been diagnosed with traumatic brain injury (TBI) with 80% being mild TBIs (mTBI), or commonly referred to as concussion.[14] Brain injuries can occur due to a traumatic event, such as blast from an improvised explosive device (IED), but are more commonly due to a mechanical origin, such as a bad airborne operation or other training event. While a vast array of potential complaints following a concussion can exist, one common symptom is neck pain or cervicogenic headaches.[15] In a literature review of current evidence related to concussion management, Broglio expands upon multiple interventions in concussion management and notes the importance of addressing neck pain and headache as both can exacerbate symptoms of dizziness and discomfort already present due to vestibular pathology.[15] He also notes that subjects who underwent 8-weeks of physical therapy focused on both vestibular and cervical spine rehabilitation were 4 times more likely to be medically cleared than a control group.[15] Often post-traumatic headache is difficult to differentiate from cervicogenic/tension headaches.

Therefore, it is important for the clinician to evaluate the type and quality of the headache pain, including a musculoskeletal evaluation focusing on frequency, severity, limitations, and triggers of the headache. If cervicogenic headache is determined, Weightman explains in an article discussing service member-specific treatment following mild traumatic brain injuries that physical therapy interventions such as postural retraining, stretching, ergonomic education, and mobilization and/or manipulation in combination with exercise have demonstrated strong evidence as well as patient education on environmental triggers.[16]

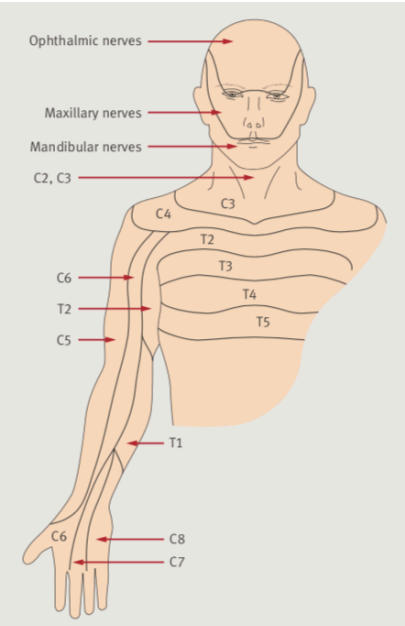

FIGURE 9

Cervicogenic headache is a relatively recent diagnosis, with multiple theories of its etiology. Page expands upon one such pathophysiological theory which suggests central sensitization of pain from the Trigeminal Spinal Nucleus as a final convergence of sensory input from the upper cervical facets, upper cervical muscles, C_2-C_3 intervertebral discs, vertebral and internal carotid arteries, dura mater of the upper spinal cord, and posterior cranial fossa.[17] Cervical Radiculopathy is another common neurological cause of neck pain, with symptoms due to nerve root compression secondary to foraminal stenosis that is clinically demonstrable in a dermatomal pattern of numbness and tingling (Figure 9[18]).[13] Aggravating factors might include activities that increase subarachnoid pressure, such as coughing, sneezing, bearing down, deep-sea diving, or parachuting from high-altitudes.[13] Another common mechanism of injury for neck pain is whiplash-associated injuries, which are acceleration-deceleration mechanisms of energy transfer that can result in soft tissue or bony injuries and is commonly due to motor vehicle accidents.[19] While motor vehicle accidents can be the cause of neck pain in a service member, this type of injury can also be seen as a result of bad airborne operations, where the individual might describe having a bad landing following a parachuting operation such as having high winds that “drag” the individual at landing.

Whiplash as well as overuse may contribute to muscle strain or guarding in the presenting service member. Neck pain may also be due to cervical musculature weakness or strain that affects the individual’s ability to stabilize the head, which is important in sensory information collection, proprioception, and the

protection of the spinal cord.[20] Muscle fatigue can have detrimental effects on stabilization as well as muscle strength. Interestingly, in a study exploring musculotendinous stiffness in the head and neck, Portero and his colleagues found that stiffness did not increase with cervical muscle fatigue despite stiffness being a common complaint of presenting patients.[20] However, the researchers did find an increase in activation of antagonist muscles with cervical flexor fatigue, which may be due to motor adaptation to mitigate fatigue and therefore recruit the net involvement of the motor complex and maintain stiffness at a constant level.[20] The antagonist muscle activity may contribute to subjective feelings of stiffness and pain throughout the neck with increased fatigue in service members.

Similar to neck pain from muscle fatigue or strain, pain may also be elicited from myofascial trigger points that can contribute to tension-type headaches.[21] Myofascial trigger points are palpable, taut bands of skeletal muscle fibers that become hypersensitive.[22] Cervicogenic headaches often demonstrate active myofascial trigger points observed as tenderness in the pericranial myofascial tissue. Do and his colleagues note that the presence of tension-type headaches are correlated with lower pain pressure thresholds which can represent central sensitization (Figure 10[21]).[21] The changes in pain thresholds should be considered within the military population, as the presence of neck pain and headache may contribute to hypersensitivity that can increase the experience of pain for other musculoskeletal injuries, which may further prevent service member function and force readiness. Changes in autonomic nervous system responses is corroborated in Morikawa's pilot study evaluating compression as a pain relief strategy in reducing sympathetic activity that contributes to overall chronic pain.[22] For example, sweating, vasodilation or vasoconstriction, and piloerection has been reported in regions of trigger points as well as symptoms of nausea when compressed. The researchers found an alteration in autonomic activity from the prefrontal cortex which can contribute to decreases in subjective pain with compression of trigger points.[22]

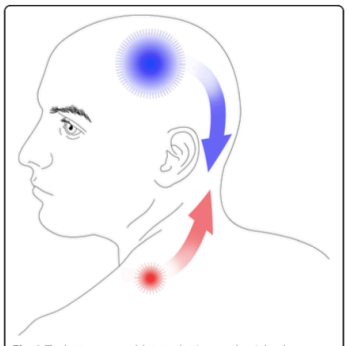

Fig. 1 The bottom-up model states that increased peripheral nociceptive transmission sensitizes the central nervous system to lower the threshold for perceiving pain while the top-down model suggests these changes are already present in central nervous system. In relation to myofascial trigger points, a bottom-up model would suggest that increased nociceptive transmission from myofascial trigger points lowers the threshold for perceiving pain (red). A top-down model would suggest that central sensitization may contribute to the occurrence of myofascial trigger points rather than the other way around (blue)

FIGURE 10

Mechanical and degenerative factors can also contribute to the development of direct neck pain and potential radiating symptoms. A common diagnosis physical therapists may see in clinic is Cervical

Spondylosis, which often presents with osteophyte formation and degenerative changes in the intervertebral discs with potential adjacent soft tissue involvement.[18] The diagnosis is typically made on clinical presentation with pain symptoms exacerbated by neck movement. Such degenerative changes can be seen in the military population, as Binder notes a high prevalence of degenerative changes in medical imaging in many individuals over the age of 30.[18] Within the military population, a high incidence of disc degeneration exists in fighter, helicopter, and transport pilots.[5,23–25] Individuals within the specific sub-population often note pain with looking over their shoulder, which is a typical "closing pattern" often associated with pain due to degenerative changes.[23] Additionally, pain with the positioning could also be exacerbated by heavy weighted helmets and oxygen masks. In a systematic review with a meta-analysis, Shiri found that pilots exposed to higher G-forces were also at higher risk of neck pain, which the authors note might aggravate pain in poor postural positions due to extended periods of time in a cockpit.[23] Work-related neck pain is very prevalent within the civilian population as well as due to high rates of "desk-time" with office computer work and extended conference meeting times as discussed previously.[7] Many service members spend extensive time working at a desk in addition to physical and combat training that can also contribute to postural fatigue and resultant pain.

Cervical Evaluation:

After physical therapists evaluate the patient, they can use the International Statistical Classification of Diseases and Related Health Problems (ICD) or International Classification of Functioning, Disability, and Health (ICF) to classify the patient's diagnosis and main impairment.[26] Appropriate diagnosis codes for the ICD can include cervicalgia, headaches, cervicocranial syndrome, sprain and strain of cervical spine, spondylosis with radiculopathy, cervical disc disorder with radiculopathy, or pain in thoracic spine.[26] When utilizing the ICF, the therapist can categorize the patient's neck pain as: neck pain with mobility deficits (b7101 – mobility of several joints), neck pain with headaches (28010 – pain in head and neck), neck pain with movement

coordination impairments (b7601 – control of complex voluntary movements), or neck pain with radiating pain (b2804 – radiating pain in a segment or region).[26] Fritz and her colleagues also developed a treatment-based classification in order to create a systematic approach to the treatment of cervicalgia, with categories including pain control, exercise and conditioning, centralization, headache, and non-cervicogenic headache (Figure 11[27]).[27] The latter is considered an indication for a referral to the patient's primary care provider for further work-up.

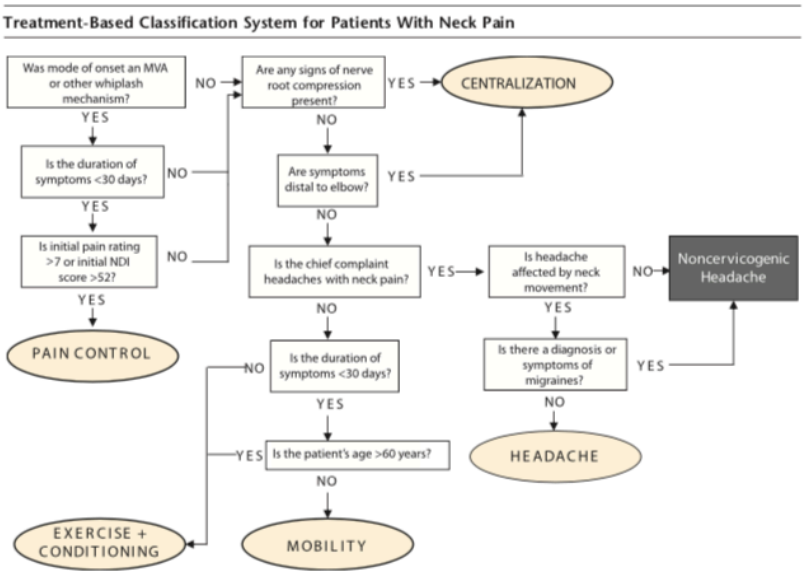

Figure.
Classification decision-making algorithm. MVA=motor vehicle accident, NDI=Neck Disability Index.

FIGURE 11

A thorough subjective interview should be performed when working with the military service member, including relevant past medical history; Military Occupational Specialty (MOS) to determine occupational demands; pain details including location, duration, frequency, magnitude, mechanism of injury, aggravating factors, easing factors, and possible activities affected by symptoms of pain.[4] When beginning the physical therapy evaluation, it is important to rule out "red flags" in order to avoid missing a more serious morbidity, such as potential myelopathy, malignancy, or systemic pathology. Red flags for myelopathy include upper motor neuron signs in the legs, lower motor neuron signs in the arms, gait disturbance, increased clumsiness with hands, or sudden onset disc prolapse in a young patient.[18] Concern for malignancy should arise if the patient notes fever,

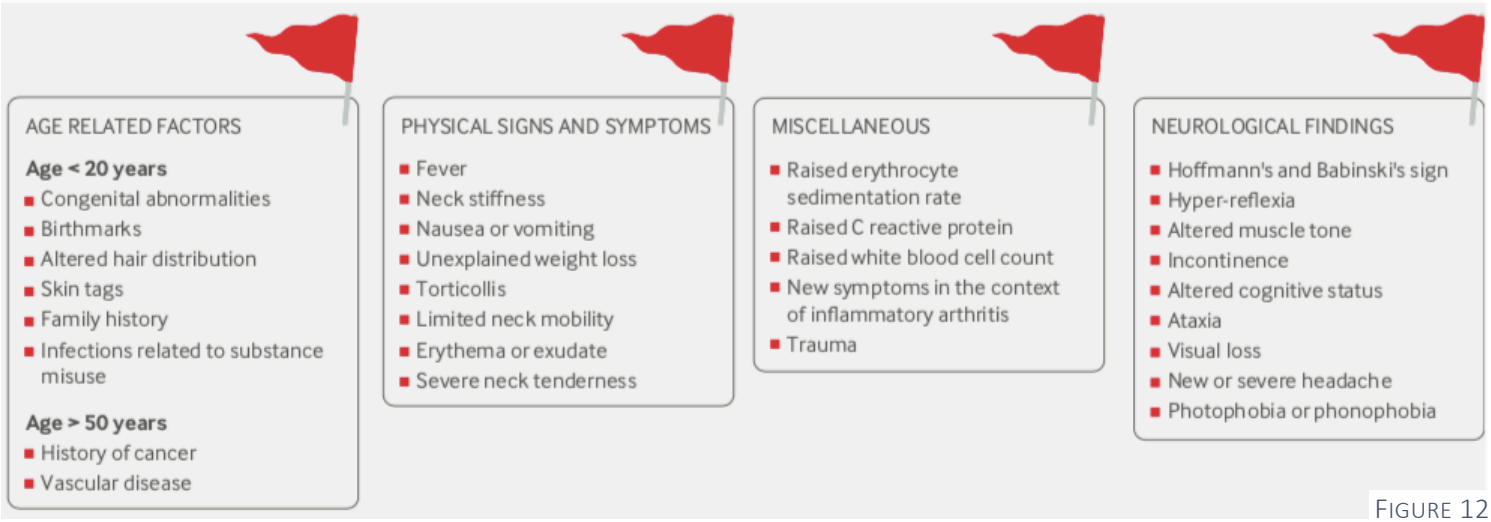

FIGURE 12

night sweats, unexpected weight loss, history of inflammation/infection/immunosuppression, excruciating pain, intractable night pain, cervical lymphadenopathy, or exquisite tenderness over vertebral bodies.[18] Other red flags that could indicate a systemic pathology and should cause the therapist to pause would include a history of neck surgery or osteoporosis, intractable pain, or drop attacks (esp. with neck movements) (Figure 12[13]).[18] Particularly in the military setting, the therapist needs to rule out potential traumatic incidents that have led to the injury, as the service member should be seen by a primary care provider for imaging to rule out serious pathology.

As the therapist moves into objective testing, establishing the service member's baseline will be beneficial in tracking progress as well as supporting the therapist's working diagnosis. When evaluating participation and activity limitations, the use of subjective outcome measures such as the Neck Disability Index (NDI) and Patient Specific Functional Scale (PSFS) have demonstrated strong evidence to identify pain, function, and disability status.[26,28] Furthermore, a basic musculoskeletal exam should occur, assessing range of motion in the cervical spine and shoulders, manual muscle testing noting any potential myotomal pattern, sensory testing noting any potential dermatomal pattern, joint play in the cervical and thoracic spine, postural assessment, reflex testing, and special testing.[13] The therapist should have a thorough evaluation to determine potential mechanical and neurological contributors, as Liu notes that 50% of the subject population evaluated in a longitudinal cohort study of chronic neck pain demonstrated both neuropathic and mechanical components of pain.[29]

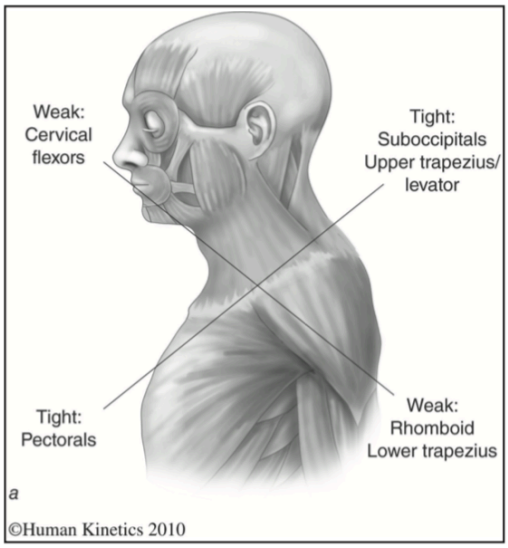

FIGURE 13

Postural malalignment and consequential poor biomechanics are often major contributors to neck pain, and therefore postural assessment should be a primary assessment performed during initial evaluation. Often forward head posture is theorized to increase stress upon the upper cervical segments. Page describes a typical postural presentation in patients presenting with neck pain, commonly referred to as Janda's Upper Crossed Syndrome, which is surmised to be a presence of weakness and tightness in opposing areas of the upper segments of the patient (Figure 13[17]).[17] Specifically, muscular weakness could be present in the

cervical flexors, rhomboids, and lower trapezius and tightness in the suboccipitals, upper trapezius, levator scapulae, and pectoral musculature.[17] Forward flexed posture can be further exacerbated within the military population as many service members spend exponential physical training time focusing on strengthening anterior musculature through bench-pressing and push-up activities.[30] A potential tool that may be useful in objectively measuring the patient's forward-head posture is the cervical range of motion (CROM) device which can numerically measure the sagittal distance from C7 to the nose (Figure 14[31]). Dunleavy and her colleagues found that it has excellent test-retest reliability and ability to achieve minimal detectable change, though the authors note it may have limited clinically meaningful applicability, as a statistically significant difference between asymptomatic and symptomatic participants was not present.[31] However, the therapist may use the CROM tool as an indicator of postural changes but not as an assessment of posture-related pain. Therapists should also evaluate positioning of musculature and ability to move into and out of different positions as well as resting position. Tightness or atrophy may be apparent in the service member as a tendency to tilt the head in one specific direction at rest, which may suggest unilateral tightness of the sternocleidomastoid, weakness on the contralateral side, or avoidance of a closing pattern on the contralateral side.[13]

FIGURE 14

After performing a thorough subjective and physical examination, the therapist can use the clinically meaningful information to support the clinical diagnosis of the presenting service member (Figure 15[13]). For a patient presenting with neck pain with mobility deficits (ICF) or cervicalgia or pain in thoracic spine (ICD), objective measures of cervical active range of motion and cervical/thoracic segmental mobility would be important to utilize.[26] For a diagnosis of neck pain with movement coordination (ICF) or sprain/strain of cervical spine (ICD), the therapist can utilize the cranial cervical flexion test or deep neck flexor endurance test.[26] Whereas, for a patient presenting with neck pain with radiating pain (ICF), spondylosis with radiculopathy (ICD), or cervical disc disorder with radiculopathy (ICD), a physical examination should include the Upper Limb Tension Test, Spurling's Test, Distraction Test.[26] A particularly useful special test that is often

used in the military population is the Neck Flexor Muscle Endurance Test and has been shown to be reliable in identifying cervical pain and dysfunction.[32] The assessment of deep neck flexor muscular performance may be of particular importance as there is an association between muscle torque and endurance deficits with complaints of neck and head pain. Furthermore, service members require sufficient head stabilization under load when wearing protective head-gear and helmets, which is often noted as an aggravating factor in the presenting patient.

Table 1 | Clinical and diagnostic evaluation of neck pain[*3-44]

Source of pain	Risk factors	History	Clinical signs	Physical examination	Diagnostic imaging	Electrodiagnostics
Axial (non-radicular)						
Facet joint	Motor vehicle collision Trauma Whiplash injury	Insidious onset	Axial neck pain Referred pain to occiput, shoulder, mid-back	Reduced neck ROM Paraspinal tenderness No neurological deficits	Weak association with facet arthrosis on plain films	Not indicated
Intervertebral disc	Smoking Advancing age Repetitive neck motions Trauma	Insidious onset	Axial neck pain Shoulder pain Non-radicular arm pain Vestibular findings	Reduced range of motion (extension > flexion; lateral bending > rotation) Midline tenderness	Plain films show reduced disc height Annular tears or fissures on MRI	Not indicated
Muscles and ligaments	Strenuous occupation Repetitive movements High impact sports	Acute or insidious onset History of whiplash injury	Axial neck pain Possible referral to shoulders and mid-back	Paraspinal tenderness Muscle guardingReduced neck ROM No neurological deficits	Plain films for fracture CT for fracture MRI for soft tissues	Not indicated
Radicular						
Nerve root compression	Middle age when caused by disc herniation Advanced age when caused by foraminal stenosis Smoking Lumbar radiculopathy Strenuous occupation	May have acute onset with disc herniationInsidious onset with spondylosis	Neck pain UE weakness in myotomal pattern Sensory changes in dermatomal pattern Upper extremity neurological weakness or numbness	Spurling's test 40-60% sen, 85-95% spec Shoulder abduction 40-50% sen; 80-90% spec Neck distraction 40-50% sen; 90% spec Upper limb tension 70-90% sen; 15-30% spec Valsalva 22% sen; 94% spec	MRI for nerve root compression False positive 45%False negative 26% CT or CT myelography to distinguish osteophytes from soft tissue changes	Electromyography 50-71% sen; 56-85% spec
Spinal stenosis	Advanced age Congenitally small spinal canal	Insidious onset	Neck pain Neck stiffness UE radicular pain	Reduced neck ROM Paraspinal tenderness	MRI for soft tissuesCT for osseous diameter of spine canal	Used for radiculopathy
Cervical myelopathy	Age>50 years Male Spinal cord trauma Syrinx	Insidious onset	Neck pain UE weakness and numbness Gait deficits Loss of dexterity	Lhermitte's sign <20% sen; >90% spec Hoffman's sign 50-80% sen; 78% spec Babinski's reflex 10-75% sen; >90% spec Hyper-reflexia >65% sen Clonus <50% sen	MRI for intramedullary hyperintensity	Used for spinal cord conduction deficits and anterior horn cell dysfunction

*Abbreviations: CT=computed tomography; MRI=magnetic resonance imaging; ROM=range of motion; sen=sensitivity; spec=specificity; UE=upper extremity.

FIGURE 15

Manual assessment of soft tissue and joints should also be performed, as it can clarify potential causes of pain as well as direct appropriate interventions. As previously discussed, muscle weakness and imbalances may often be perceived as "tightness" or pain. Therefore, the therapist should take sufficient time to assess surrounding soft tissue, including palpation of muscles to identify myofascial trigger points, paying particular attention to the sternocleidomastoid, upper trapezius, temporalis, suboccipital triangle, levator scapulae, rhomboids, middle trapezius, and lower trapezius.[17] Soft tissue assessment may also include assessment of passive range of motion to determine tightness, such as in the pectoralis muscles or upper trapezius as seen in Upper Crossed Syndrome.[17] The therapist can then evaluate the service member's segmental mobility within the

cervical and thoracic spine, as abnormal mobility often contributes to head and neck pain.[17] In the military population, often service members will demonstrate hypomobility which may indicate the need for joint mobilization and/or manipulation as an intervention. However, the therapist should take the time to evaluate vertebrobasilar artery (VBA) sufficiency, as headache and neck pain can be the preliminary symptoms of VBA stroke and would be cause for referral to a physician. Childs warns clinicians in a commentary on VBA testing in the setting of manual therapy decision-making that insufficient current evidence exists that supports the therapist confidently concluding negative screening, though he does report that risk of VBI does appear to be low.[33] He further suggests that cervical techniques should not be performed at end range positions in order to reduce the risk of adverse events as well as the patient being sufficiently informed of the risks and benefits in order for the individual to make an informed decision.[33]

Evidence-Based Interventions:

Extensive research is available regarding best practice in the treatment of neck pain in the civilian world, though the research in the military appears to currently be limited to aircrew members. Multiple interventions have been evaluated, with the current clinical practice guides reporting the strongest evidence favoring therapeutic exercise and manual therapy.[26,28] Additionally, other methodologies have also been suggested, though the evidence in support is weak. Some other strategies include instrument-assisted soft-tissue work, dry-needling, traction, electrical stimulation, and Kinesiotaping.[13]

Cervical mobilization and manipulation (thrust and non-thrust) procedures have demonstrated strong evidence to reduce neck pain and headache, with its use in combination with exercise proving to be most effective in reducing discomfort and disability.[26] Thoracic manipulation has also been suggested in reducing neck pain with neck-related arm pain, though weak evidence supports the approach.[26] In a systematic review with meta-analyses, D'Sylva and his colleagues found that the use of mobilization, manipulation, and soft-tissue techniques demonstrate greater improvements in patient satisfaction, quality of life, global perceived effort, pain, and function, particularly when in combination with exercise and patient education.[34] Furthermore, they found that a clinically important, though not statistically significant, benefit supports the utilization of

mobilization and manipulation in short- and long-term improvements in pain and function when compared to no treatment or placebo.[34] Escortell-Mayor evaluated the benefit of manual therapy techniques in comparison to the use of transcutaneous electrical nerve stimulation (TENS) in improving pain intensity, and found that both techniques produced clinically-relevant, short-term improvements in pain though changes were not maintained at 6-months.[35] Therefore, the sole use of either of the modalities would be insufficient in maintaining long-term pain relief in patients. Within the military, however, the use of TENS may be beneficial for short-term improvement in time-constrained, medically-inaccessible situations, such as when service members are deployed. Interestingly, in a questionnaire given to fast jet aircrewmen reporting flight-related neck pain, Netto and his colleagues found that manipulative care was reported to produce the greatest relief in pain.[36] Walker further adds to the support of manual therapy in a study comparing patients undergoing a combination of manual and exercise therapy as compared to minimal intervention in the treatment of mechanical neck pain and found statistically significant improvements in short- and long-term disability index scores and pain ratings.[37] Particular assessment and potential mobilization from C_5-C_7 may prove to be beneficial as C_6-C_7 and C_5-C_6 discs are the most common nerve roots involved with cervical disc herniation, which may be indicated with numbness tingling in dermatomal distribution or reflex testing.[38]

Neck pain has also been heavily linked to psychological and social factors such as depression, anxiety, and job satisfaction.[13,38] However, Oostendorp notes that psychological and social dimensions of chronic pain are rarely addressed in combination with manual therapy, despite the plethora of research noting the connection of psychosocial factors with chronic neck pain.[39] As occupation factors often contribute to pain in the military population, it may be beneficial for therapists to address psychological factors contributing to pain, such as blaming their service branch for an incurred injury, stress-factors, or other implications in order to improve the service member's neck pain and function.

The use of therapeutic exercise has consistently demonstrated strong evidence in support of improving neck pain and function.[26,28] Within the military population, extensive research has been performed evaluating conservative management of neck pain in aircrew members, though limited research has evaluated the

prevalence or risk factors in other branches or MOS's. Alagha examined the use of spinal manipulation and mobilization therapy in combination with exercise therapy in treating helicopter pilots with non-radicular, range-limited chronic pain and found a statistically significant improvement with the combination of both treatments.[24] Exercise was also shown to be effective for an F-18 fighter pilot in a case-study performed by Green and his colleagues as well as a randomized control trial for helicopter pilots performed by Salmon and her colleagues.[40,41] Salmon found that neck coordination training as well as endurance training demonstrated improvements in maximal force and muscle endurance, with coordination training demonstrating the greatest significant trends.[40] Lange demonstrated the efficacy of a 24-week training intervention targeting deep neck muscles in reducing neck pain in F-16 pilots, noting the need for intervention due to repeated G-force induced, whiplash-like exposures.[42] The theory could potentially be translatable to other military service members, such as paratroopers, as whiplash-like sensations are experienced with exiting the plane during static-line jumping. The skilled services of physical therapy in coaching patients to complete exercises has also demonstrated benefit. Alricsson found that pilots who were reminded to complete neck strengthening exercises demonstrated statistically significant improvements in musculature strength when compared to a group that did not receive reminders from a physical therapist.[43] Specific training of involved musculature is also indicated, as suggested by Anderson and his colleagues who compared the effect of strength training of the lower trapezius as compared to generalized strength training of uninvolved musculature (leg bicycling) and found a greater statistical improvement in pain reduction in the first group.[44]

Multidimensional interventions may also improve ratings of pain and function. Cohen notes the potential benefit of a multidisciplinary approach to treating neck pain, such as epidural steroid injections, physical therapy, and nortriptyline and/or gabapentin, as the combination group in a randomized comparative study of active service members and veterans demonstrated greater improvements as compared to stand-alone treatments.[45] However, it should be noted that steroid treatment may produce detrimental, degradative effects on collagen that can place the patient at risk of worse adverse events.[46] Therefore, the therapist should approach loading the neck cautiously following steroid injections. Murray proposed a specific 20-week protocol for

strength training in combat helicopter pilots, which he notes demonstrated statistically significant improvement in pain and function.[47] The authors utilized activity-specific training that replicated functional demands on the neck musculature, which would be beneficial in the military setting, such as maintaining neck stability with seated trunk movements (Figure 16[47]).[47] External validity and activity-specific training is of particular focus when working with military service members. In an evaluation of muscle activation levels in combat pilots, Netto demonstrated that muscle activation when performing elastic band exercises were similar to muscle activation at lower G-force levels, and therefore elastic-band training may be translatable to low G-force pilots.[48] However, mimicking maximal strength loads for high G-force pilots may be difficult and potentially risky due to unknown spinal loads.

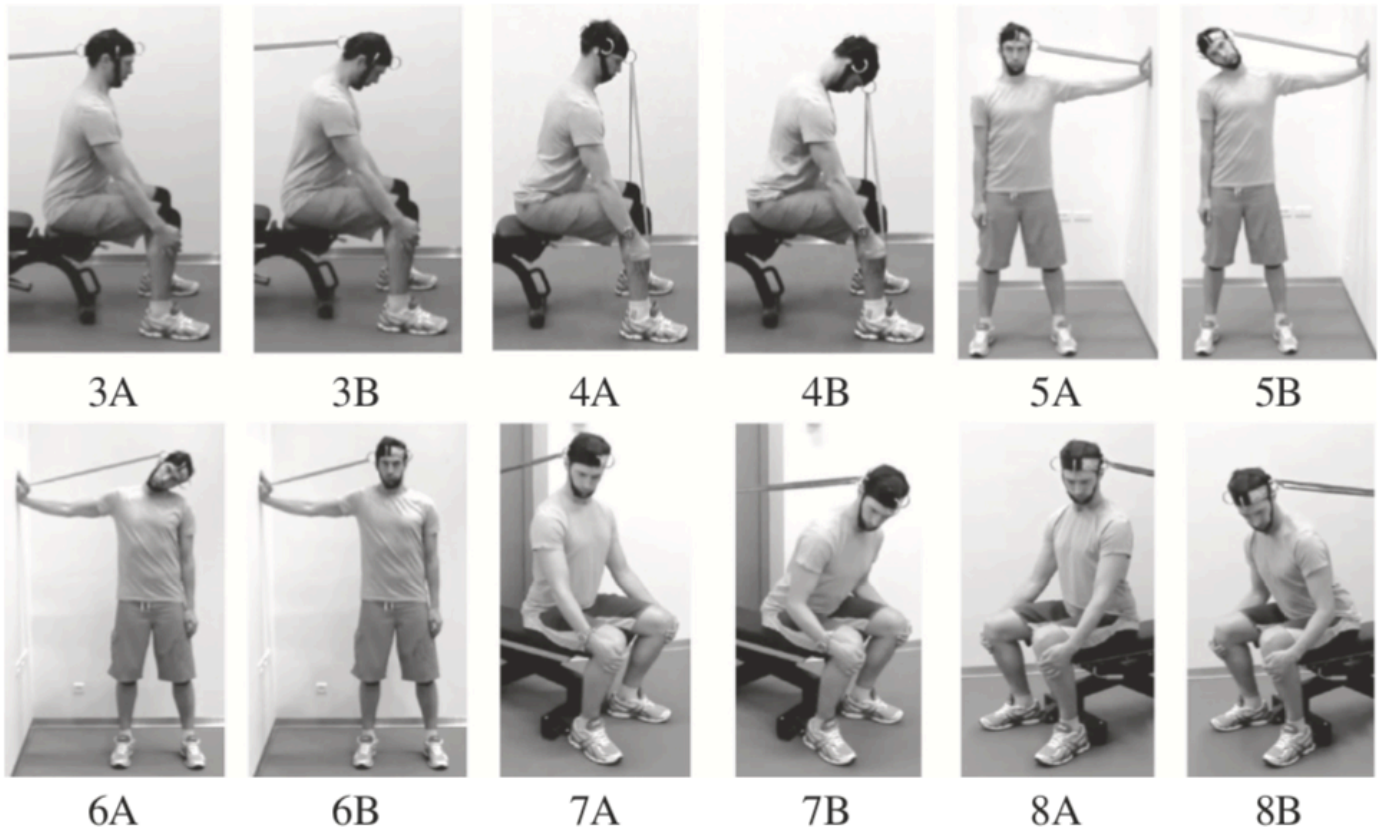

Fig. 3 Training exercises for the neck. Training exercises for primary neck muscles during flexion (Exercise 3 **a** + **b**), extension (Exercise 4 **a** + **b**), lateral flexion to the right side (Exercise 5 **a** + **b**) and left side (Exercise 6 **a** + **b**), flexion/rotation to the right side (Exercise 7 **a** + **b**) and left side (Exercise 8 **a** + **b**)

FIGURE 16

Many other modalities that have been suggested to treat patients with neck pain. Pharmaceutical intervention, including analgesics such as nonsteroidal anti-inflammatory drugs or topical capsaicin, are often the first treatment for service members presenting with neck pain as they have demonstrated rapid relief.[49]

However, most therapists do not prescribe analgesic pharmaceuticals as it is not within the scope of practice unless they are employed by the United States Department of Defense (DoD) or Department of Veterinary Affairs (VA). As soft-tissue intervention has demonstrated some benefit in improving pain scores, Page suggests the use of instrument-assisted soft-tissue mobilization as fascial adhesions between the suboccipital muscles and upper cervical dura around the cranial fossa and C_2 vertebra may restrict normal movement.[17] Another modality that has been growing in popularity in the field of physical therapy is dry-needling. Guthrie suggests its use as well as the application of battlefield acupuncture, which is an auricular acupuncture technique proposed in the treatment of pain in combat situations that require the mental clarity of service members which can be altered by the use of pharmaceutical analgesics.[50] In a case study performed on a marine, Guthrie notes that the subject reported vast decreases in pain, improvements in sleep quality, and function after five treatments.[50] It may be a promising technique in expediting pain relief as well as a safe alternative for service members, though high-quality research is still needed to support its use. Another potential modality that has been used in the setting of neck and back pain is traction. Cleland reports that subjects with neck pain reported improvement in pain and function following manual therapy, cervical traction, and strengthening exercises.[51] However, the study was low-quality as a case series and demonstrates high-bias as benefits may have been more significant from manual therapy and strengthening. Furthermore, the current clinical practice guidelines reports weak evidence in support of the use of traction in relieving pain.[28] In a randomized clinical trial exploring the efficacy of kinesio-taping as an adjunct modality in the treatment of neck pain following an acute whiplash injury, Gonzalez-Iglesias and his colleagues found that a statistically significant improvement was found immediately following application with proper tension and at a 24-hour follow-up period when compared to a placebo taping method (Figure 17[19]).[19] However, the authors note that the improvements in cervical range of motion and pain were minor and may not be clinically meaningful. Some evidence exists suggesting the efficacy of prophylactic neck and shoulder exercises in reducing neck pain in helicopter pilots. In a randomized controlled trial, Ang and his colleagues found a

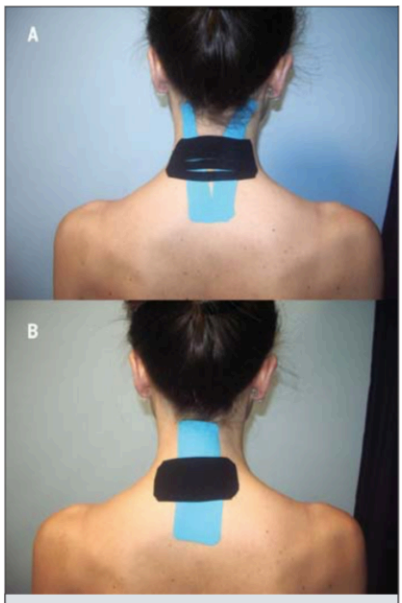

FIGURE 1. The placement of the Kinesio Taping for both conditions. Kinesio Taping placed with tension (A) and Kinesio Taping placed without tension (placebo) (B).

FIGURE 17

significant decrease in the prevalence of neck pain in participants performing exercises as a preventative measure when compared to a control, non-exercise group.[25] With the plethora of potential modalities in treating neck pain, high-quality evidence is needed to support the inclusion of such techniques in clinical strategies. Wong reports in a systematic review that currently, mobilization, manipulation, and clinical massage are effective interventions, but passive modalities such as heat, cold, diathermy, ultrasound, or electroacupuncture are not effective in reducing pain.[52]

Conclusion:

Neck pain is a common yet complex diagnosis that many orthopedic physical therapists will see throughout their career. Within the military population, the prevalence of neck pain or injury poses a threat to individual service member health and function as well as overall force readiness. Multiple risk factors can contribute to high rates of neck pain, including specific MOS demands, extended hours of desk work, combat-exposure, and psychological factors. Furthermore, broad mechanisms of injury can contribute to the presentation of neck pain. It is important that physical therapists who work with the military population are best prepared to utilize appropriate testing methodology and evidence-based interventions, such as manual therapy or therapeutic exercise, in order to optimize the service member's health and the military branch's force readiness.

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