Between Interior And Exterior: An Integrative Review Of Tuina And Acupuncture For Cervical Spondylosis

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ABSTRACT

Objective: Cervical spondylosis is among the most prevalent musculoskeletal diseases worldwide and it is expected that it will affect significantly more people in the coming years. Tuina and acupuncture have been treating cervical spondylosis for many years, even before it was probably recognized as a separate disease. An investigation into the parameters of their combination with regard to the efficacy, safety, and applicability, together with an attempt to elucidate their roles, and the mechanisms by which they act would provide a framework for their proper use by the TCM therapist.
Methods: Large databases were searched for studies of acupuncture and Tuina in the context of cervical spondylosis, published in the last 10 years. In total, 23 studies were discovered. Their procedures, results, and other parameters were recorded and compared to each other. The methods used were researched in order to determine their correct and safe use, the rationale behind their application, and a research into the conclusions of the current literature regarding these methods. Also, the context within which acupuncture and Tuina should be used and how they are combined was looked into. With the understanding and the information gained by such an investigation, a suggestion for the use of Tuina therapy in the clinic emerged.
Results: Overall methodological quality was low to moderate. The combination of acupuncture and Tuina was superior to either alone. From a biochemical perspective they may offer the same benefits, but in TCM they address different aspects. Tuina is necessary to address the structural components of the disease. In some aspects, both approaches are interchangeable which offers flexibility in treatment. Pulling manipulations are generally safe, but should be discontinued after achieving their results. The occipital, and thoracic regions should always be included in treatment. Assessing global spinal balance may enhance the therapeutic result.
Conclusions: Tuina and acupuncture are an effective conservative treatment for cervical spondylosis, which due to the nature of TCM, may offer deeper benefits to the patients. More rigorous studies should be performed to validate this conclusion. Further investigations are necessary to elucidate the mechanisms through which they operate.
According to literature, the mental-emotional aspect of pain is not to be underestimated. Qi and Blood deficiency as a pathogenesis may refer to both a systemic one, and to the blockage of the local meridians. Where advanced degeneration is not a factor, auricular acupuncture treating the shaoyang meridians can be effective.

1. INTRODUCTION

1.1. Current Status Of Cervical Spondylosis

Cervical spondylosis (CS) is an umbrella term referring to symptomatic degenerative changes affecting the cervical spine, the most common symptom being neck pain.[1] Although it is associated with aging, it is increasing in people under the age of 50 due to the pressure imposed by modern work and lifestyle habits. It is estimated that the prevalence of neck pain will increase by 32.5% in the next 26 years.[2] Neck pain along with lumbar pain are the fourth leading causes of DALY (disability adjusted life years) and the first cause of YLD (years of healthy life lost due to disability).[3] Since cervical spondylotic changes are responsible for a large percentage of this type of pain,[4] pain relief is a major goal of treatment.

Age is still the most important risk factor for the appearance of CS, which mostly relates with the degeneration of the cervical disk.[5] But CS is strongly related with postural factors and the type of work an individual does as well. A study among IT professionals found that the prevalence of CS radiculopathy among them was 50%, with age and working time being the most important risk factors.[6] Another study found that the prevalence of neck pain among dentists reaches 73%.[7] Hence, it becomes clear that, apart from degenerative aging changes, other factors such as posture and lifestyle may be equally important.

Until now, there have been many non-operative treatments for CS, the first line of treatment being the use of NSAIDs. Their effectiveness varies widely with each case, with one reason being that the role of inflammation in CS is different in each case, while another is the different mechanisms of action of any particular medicine. A study in rats with nerve-root type CS found that non-selective COX inhibitors are more effective.[8] Despite their questionable efficacy, long-term use of NSAIDs comes with a variety of associated health risks such acute renal failure, cardiovascular diseases, gastrointestinal disorders, asthma, and an elevated risk for congestive heart failure in older adults when misused.[9,10] Further pharmacological steps when NSAIDs prove ineffective are opioids and muscle relaxants which due to their potential for addiction, should be avoided as a long-term solution.

1.2. The role of Tuina in CS

Manual therapy is a part of a number of conservative treatments proven effective for several types of CS.[11,12] Tuina comprises the manual therapy part of TCM, however, due to its underlying principles, it is systematically applied to diseases that are not typically treated by conventional manual therapy, and therefore its methods and applications need to be examined. A proper introduction to its underlying principles then becomes necessary to understand its proper role.

1.3. The principle of Holism

Holism, which derives from the Greek word όλον (holon – roughly translates to “whole”), states that the principle behind the examination of anything starts from viewing not just the thing being examined, but also examining its relationship with the environment that it is a part of. In medicine, this requires the examination of the diseased part in relation to the whole body system. This principle is not exclusive to Tuina but governs the whole of Chinese

Medicine starting from its inception. Tuina therefore regards not only the local musculoskeletal manifestations of CS but their relationship to the whole physiology of the human body, according to TCM. Hence, CS is also connected to the meridians, Zang-Fu, tissues, Qi, and Blood.

1.3.1. Actions of Tuina[13]

The most fundamental theory that is the foundation of TCM is the Yin Yang theory. Yin-Yang is a pair of opposites used to describe any manifestation of the observable universe. All aspects of the human body have a yin and yang aspect, such as the sleep-wake cycle, inhibition and excitement, front of the body to the back of the body, etc. The maintenance of health depends on the dynamic balance of Yin Yang, and any disturbance would manifest itself as a pathological condition. The examination of the state of Yin and Yang is part of any TCM treatment, including Tuina. By selecting appropriate manipulations and applying them with the necessary intensity, duration and force, Tuina can regulate Yin and Yang by activating the meridians, dispersing accumulations and promoting circulation. Another important TCM theory is the Zang-Fu theory which contains of the role of the internal organs in human physiology. By influencing the meridians, Tuina can stimulate the internal organs to induce the required effect. Another mechanism of action of Tuina is the opening of meridian and collaterals. Through the collaterals, the internal meridians communicate with the tissues of the body such as the muscles, etc. By working on the meridians and the collaterals, any accumulation of qi and blood in the tissues can be removed, restoring the balance of Yin Yang, Qi, Blood, and body fluids.

2. ETIOLOGY AND PATHOLOGY OF CERVICAL SPONDYLOSIS

2.1. CS According To TCM

CS has no specific disease name in TCM but it is generally classified according to its symptom, although it is mostly considered to belong in the Bi zheng – impediment conditions disease category, specifically Xiang Bi- Neck Bi and Gu Bi- Bone Bi, while also appearing in Wei Zheng – wilting conditions category, Yun zhen – dizziness, Jing qiang – stiff neck, Jing jin ji – neck sinew cramping or tension, jing jian tong – neck and shoulder pain[14]

The Huangdi Neijing Lingshu (HDNJLS) [15] chap. 4 provides the basis of the nature of the disease: “The head, the face, and the entire physical body are tied to bones and connected through sinews……. In the exterior, the sinews and bones are yin and the skin is yang.” In the same chapter it states that “Diseases situated in the yang realm, they are called wind. Disease situated in the yin realm, they are called blockage illness.” A description from The Systematic Classic of Acupuncture & Moxibustion (ZZJYJ) [16] provides the link between CS and the sinews and bones:

“When the disease lies in the bone, the bones become heavy and cannot be lifted, along with aching pain in the bone marrow and the arrival of cold qi……. When the disease lies in the sinews, the sinews become hypertonic.” As is mentioned in the Yi Lin Gai Cuo – Correcting the Errors in the Forest of Medicine section 34,[17] “the general name of all shoulder pain, arm pain, waist pain, leg pain, or generalized pain is impediment pathocondition.” Obstruction and impediment are two interchangeable terms that are found in the Huang Di Nei Jing, which are presumably used to differentiate these two conditions, that is the existence of an

internal pathogen in the tissues with or without a lingering exterior pathogenic factor. We can then consider CS it as an illness of obstruction, or rather an accumulation, regardless whether it's complicated by wind-cold-damp thus belonging to Bi syndromes, or not.

A statistical analysis of 252 cases of medical records in China found that Qi stagnation and blood stasis was the most common syndrome in CS patients,[18] which validates this view. This however, may be sufficient to account for the symptoms associated with CS, neck pain, headache, numbness of the limbs, headache etc. but not for the whole spectrum of symptoms nor its causative factors.

Being associated with an increase in age suggests that the physiological environment that rules this life stage. In the Huang Di Neijing Su Wen (HDNJSW)[19] chap.5 it states that "at the age of forty, the yin qi has decreased to half of its own [former amount]" referring to the decline in kidney essence. According to the HDNJSW, ageing is characterised by a condition of depletion below and repletion above, meaning that the decline of the kidney essence results in the inability of the kidneys to promote transformation, with this eventually leading to qi stagnation, phlegm, and blood stasis occurring particularly in the upper areas of the body. Further results of this is the decline of the liver's ability to dredge the meridians and regulate the flow of Qi, and of the spleen and stomach to upbear the clear yang.

Kidney essence is composed of both kidney yin and kidney yang, and CS may occur against a deficiency of either. Marrow belongs to the kidney, and the state of the sinews and bones is very much dependent on marrow, which in turn is dependent on the transformation of qi and blood. HDNJLS chap. 47 reads:

"When the blood is harmonized, then it will flow freely through the conduit vessels and circulate through the yin and yang [realms]. The sinews and bones are strong. The joints are clear and flexible…… when cold and warmth are harmonized, then the six short-term repositories transform the grain and no wind blockage illness sets in." This passage links marrow, qi, and blood quite nicely.

Marrow both fills the bones and lubricates the joints. In the 12th issue of Nanjing[20] it reads: "the kidneys and the liver are located below the diaphragm; they are passed by the qi of the earth. They store essence and blood, and they are more closely related to the bones and the marrow." Their interconnectedness is also highlighted by the statement in Chap. 59 of the HDNJLS: "the joints of the bones are the places where the hollow space in the bones is filled." Internally, both organs can influence promote the appearance of CS. Insufficiency of kidney yin will lead to the inability of liver yin to lubricate the joints and restrain liver yang causing the characteristic pain and stiffness of the neck with the restricted range of motion. On the other hand, damage to liver blood/yin can influence kidney yin and therefore the bones. According to the theory of the five exhaustions – Wu Lao excessive standing harms the bones and excessive viewing harms the blood, both of which are very widespread due to the extended use of computers in our modern lifestyle. In fact, a 2017 study on 60 patients of patients with CS with a liver blood deficiency, found the participants having an average age of 34 years old, a number quite lower compared with other studies on CS,[21] which may be something worth keeping in mind when dealing with younger patients.

In chap. 34 of the HDNSW we read:

"The kidneys, they are water, and they generate the bones. When the kidneys fail to generate, then the marrow cannot be filled up. Hence, extreme cold reaches the bones. The reason why [this person] cannot tremble with cold is [as follows]: The liver is the first yang, the heart is the second yang. The kidneys are a solitary depot. One water cannot overcome two fires. Hence, [the patient] cannot tremble with cold. The disease is called 'bone block.' A person with this [disease] will have tight joints."

The production of marrow is closely related to the state of the spleen and the kidney yang. A deficiency of both will result in the symptoms described above. Bone block or bone bi has the

symptoms of soreness and pain in the joints and bones, numbness and heaviness of the body and limbs, heavy sensation in the affected parts, and stiffness of the joints, which are difficult to move, as well as bone deformity.[22] All these are common in CS patients.

From the above it also becomes obvious that an exterior invasion is not prerequisite for the development of cold. Chap. 35 of the HDNJLS further clarifies this:

"When the great yang is depleted, the lower back and the backbone, as well as the head and the nape have pain. When all three yang are depleted, then the yin qi dominates. When the yin qi dominates, then the bones cold and ache. The cold is generated inside."

In addition to the insufficiency of marrow, a deficiency of spleen and kidney yang will result in lack of Wei Qi, which is responsible for the firmness and warmth of the interstices. In chap.81 of the HDNJLS says regarding this:

"The stomach and the intestines receive grain; the upper burner releases qi. It is to them to supply the partings of the flesh with warmth, and to nourish the bones and the joints, as well as to penetrate the skin structures." A deficiency of yang qi will therefore make an exterior invasion all the more possible, with or without, the pre-existence of an interior pathogen. Chap. 56 of the HDNJSW describes how an exterior invasion proceeds to cause musculoskeletal pain:

"When [the evil] has entered the conduits and has settled there, the [the conduits] experience depletion and [the vessels] sink down. When it stays in the region of sinews and bones, in case it [consists of] plenty of cold, then this causes sinew cramp and the bones to have pain."

Since the exacerbation of symptoms depends on the type of pathogen, any change in the degree of pain according to the weather pattern can also serve as an indicator of the type of pathogen that predominates. Another thing to keep in mind is that since the disease is located in both types of tissue the predominant symptoms may change according to the weather pattern.

Although cold, either generated internally either invading from the exterior (carried by wind), is the pathogen that determines the manifestation of the disease, cold also plays a part in the creation of damp. Ch. 36 of the HDNJLS says: "When cold remains in the partings of the flesh, it condenses [the body liquids] to turn into foam, and this causes pain."

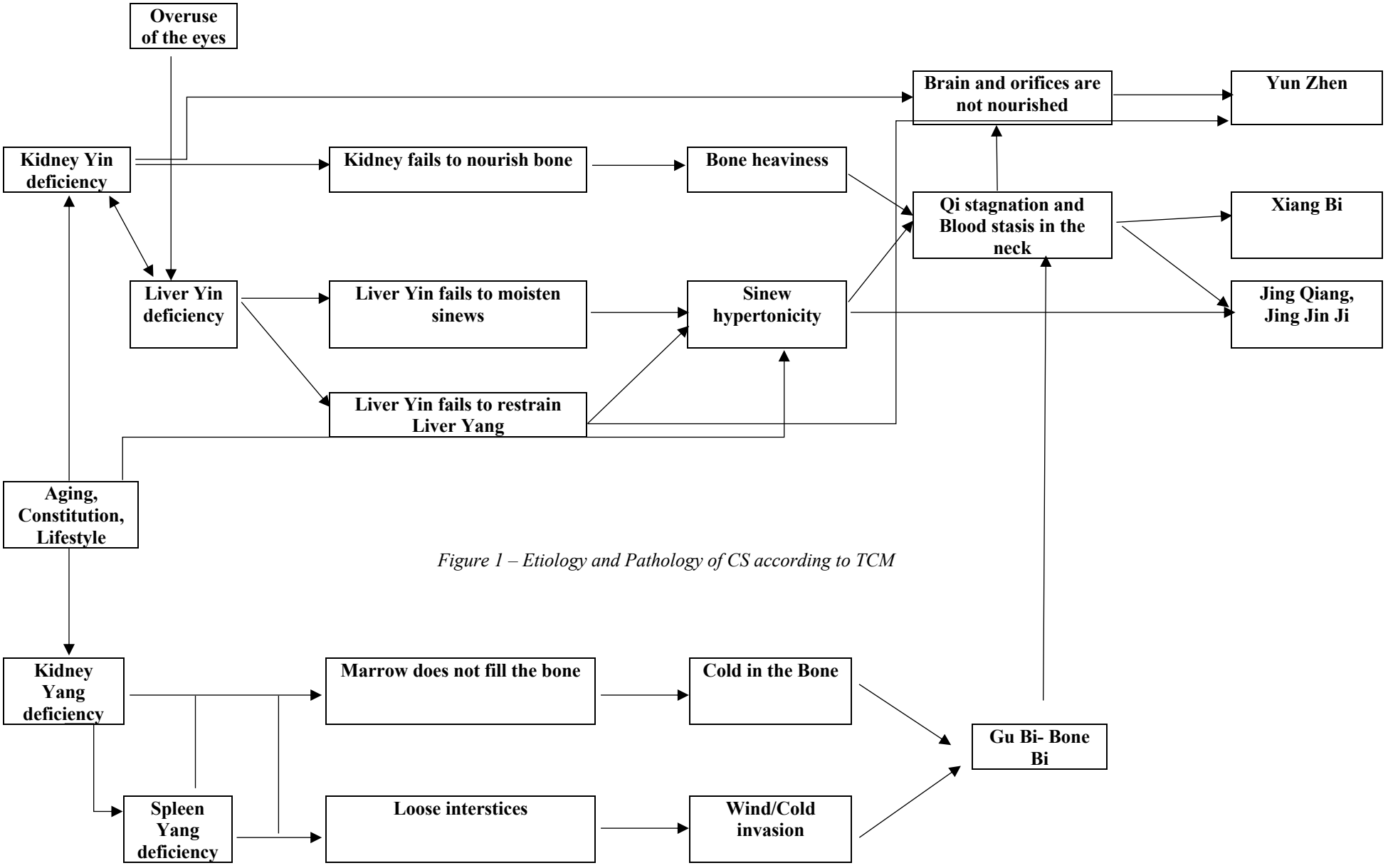

Figure 1 – Etiology and Pathology of CS according to TCM

2.1. Definition of Cervical Spondylosis According To WM

CS encompasses a range of symptoms associated with multifactorial degenerative alterations in the cervical spine, leading to a reduction in the size of the spinal canal and neural foramina.[23] This definition is occasionally broadened to encompass all non-specific pain, although it is important to note that neck pain may also arise from postural habits. [24] The degenerative processes that characterize CS primarily involve the deterioration of intervertebral discs, the formation of bone spurs, the stiffening of ligaments, and the occurrence of herniated discs, with axial neck pain being the most prominent symptom. Approximately 95% of individuals aged 65 and older exhibit the changes typical of CS,[25] underscoring the necessity of clinical symptoms to validate the diagnosis, in addition to imaging results.

The factors contributing to the narrowing of the spinal canal and the subsequent development of CS include the following:

- Intervertebral disc degeneration: This condition is primarily associated with the early stages of spondylosis.[26] The aging process leads to a reduction in water content and alters the ratio of keratin sulfate to chondroitin sulfate, diminishing the disc's capacity to support axial loads and resulting in a decrease in its height. Initially, this degeneration may cause the disc to bulge or herniate, alongside hypertrophic degenerative inflammatory changes in the facet joints,[27] leading to cervical spine instability. This instability increases the load on the facet joints, ultimately resulting in the formation of reactive osteophytes. Additionally, the reduction in disc height can lead to progressive kyphosis in the cervical region, further exacerbating axial load, often necessitating surgical intervention such as ventral column stabilization.[28]
- Cervical joint degeneration: This degeneration may occur independently of intervertebral disc degeneration.[29] . Notably, both hypertrophy and ossification of the posterior longitudinal ligament (PLL) and the ligamentum flavum (OLF) have been documented.[30] The increase of axial load, whether resulting from disk degeneration or other mechanical influences, leads to hypertrophy of the facet joints, or alternatively, to degeneration of both the facet and uncovertebral joints.[28] Focal pain arising from the degeneration of a cervical facet joint is regarded by some as a specific subset of degenerative cervical spondylosis (DCS), although it is relatively uncommon. The facet joints are supplied by nociceptive nerve fibers, which then become a source of pain in those cases.[30]
- Segmental instability: Segmental instability is a major hallmark of degenerative changes and a common cause of axial and radicular pain.[31] It may also initiate spondylotic changes. Spinal stability relies on the vertebral column and the muscles. The cervical muscles often exhibit weakness in CS, particularly the deep cranio-cervical flexors.[5] This weakness can arise from disuse, overuse, or injury, potentially resulting in segmental instability. Such instability may or may not be detectable through imaging studies. [32] Atlantoaxial instability primarily involves the downward displacement of the rostral facet of the atlantoaxial joint over the inferior facet. This condition can result in a decrease in the dimensions of the neural foramina, spinal canal, and intervertebral body space, in addition to causing abnormal stress on the intervertebral disc, which may subsequently trigger compensatory muscle spasms.[33] Subsequent changes such as ligamental hypertrophy, disk space reduction, and osteophyte formation, may take place to reduce

mobility.[34] In cases of advanced spondylosis, the formation of osteophytes and alterations in joint structure further exacerbate the stenosis of the central canal.[27]

- Herniated intervertebral disc: Herniated intervertebral discs can serve as an early indicator and contributing factor to CS, and predominantly occur at the C5-C6 or C6-C7 levels. Compared to spondylotic discs, herniated discs elicit a more pronounced inflammatory response, although the clinical manifestations are very similar. A herniated disc is characterized by a more localized protrusion, affecting less than 25% of the disc's circumference, which enhances its potential to compress the spinal canal or nerve roots. Furthermore, hernias can be classified as either "hard" or "soft," based on their predominant material composition. A "hard" hernia is encased by osteophytes, whereas a "soft" hernia primarily consists of the disc material itself. In the cervical region, herniations are more frequently observed in the lateral aspect, particularly adjacent to the posterior longitudinal ligament.[35]
- Osteophyte formation: Late-stage spondylosis is characterized by its prevalence in individuals over the age of 55, distinguishing it from herniated discs. This condition is most frequently observed at the C6-C7 intervertebral level, followed by the C5-C6 level, as these segments are primarily responsible for a significant portion of cervical motion. Degenerative changes, including the formation of osteophytes, are commonly found across multiple levels of the cervical spine, affecting approximately 60% to 85% of patients.[36] As noted earlier, the degeneration of intervertebral discs results in increased stress on the facet joints, prompting the formation of osteophytes as a compensatory response to this heightened load.[26] The imbalance in loading on the vertebral rim, AF, and EPs resulting from disc degeneration or improper posture contributes to the emergence of instability, stemming from the compromised integrity of the structures that constitute the spinal motion segment (SMS).[5] This persistent mechanical stimulus stimulates the periosteal cells towards abnormal bone growth in an attempt to stabilize the segment and maintain the load bearing capacity which leads to osteophyte growth.

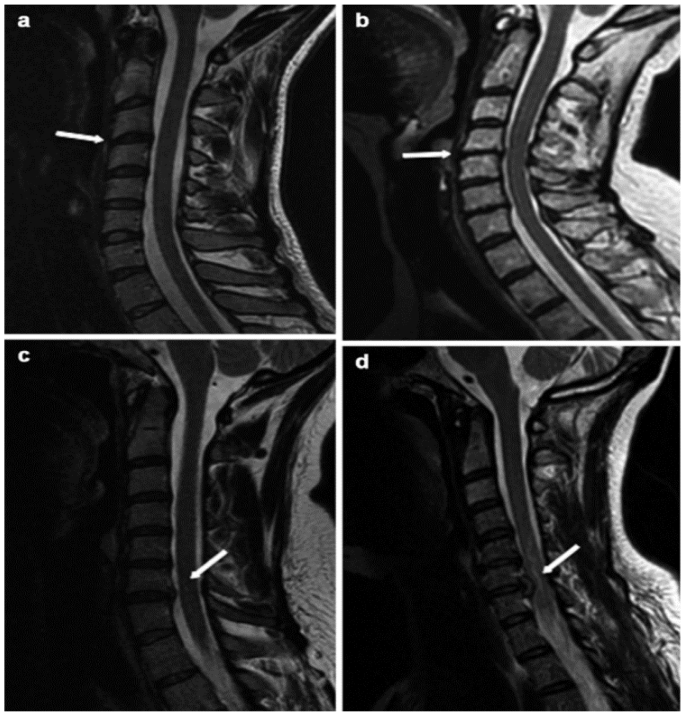

Figure 2 *Age-related disk modifications, disk bulging and disk herniation shown on sagittal FSE T2 images.*
(a) Minimal disk dehydration at C3-C4 level (arrow).
(b) Progressing degenerative changes with mild disk height reduction and mild spondylotic alteration at C4-C5 level (arrow)
(c) Posterior disk bulging at C6-C7 level (arrow)
(d) Disk herniation at C6-C7 level (arrow)
Source: Di Lella, G.M., Costantini, A.M., Monelli, E., Guerri, G., Leone, A., Colosimo, C. (2022). Diagnostic Imaging in the Degenerative Diseases of the Cervical Spine. In: Menchetti, P.P.M. (eds) Cervical Spine. Springer, Cham. https://doi.org/10.1007/978-3-030-94829-0_3

Figure 3 *Lateral X-ray showing early degenerative changes, mild straightening of the cervical spine, mild narrowing joint space at the C5-C6 level, mild narrowing joint space at the C6-C7 level with anterior and posterior osteophytes. Patient is male, 45 years old, presenting with right-sided neck pain.*

Source: https://radiopaedia.org/cases/cervical-degenerative-spondylosis?lang=gb

Figure 4 *Sagittal T2 image example of a multilevel cervical spondylosis. Straightening of the cervical spine with disc space narrowing at C4-C5, C5-C6 and C6-C7.*
Spinal levels as detailed below:
C2-C3 disc space: No disc herniation. Uncovertebral arthrosis contributes to mild left foraminal narrowing.
C3-C4 disc space: Large central disc protrusion resulting in severe spinal canal stenosis and cord compression with ventral cord deformity. No cord signal abnormality. Uncovertebral arthrosis contributes to moderate left and mild right foraminal narrowing.
C4-C5 disc space: Disc osteophyte complex resulting in mild cord compression and ventral cord deformity. Moderate to severe spinal canal stenosis. Facet/uncovertebral arthrosis contributes to severe left and mild right foraminal narrowing.
C5-C6 disc space: Disc osteophyte complex and facet/uncovertebral arthrosis with mild spinal canal stenosis, and severe left foraminal narrowing.
C6-C7 disc space: Disc osteophyte complex and facet/uncovertebral arthrosis without spinal canal stenosis. Severe right and moderate to severe left foraminal narrowing.

Source: https://radiopaedia.org/cases/multilevel-cervical-spondylosis?lang=gb

2.2. CS TYPES

In the majority of the literature around CS, three primary classifications are identified

1- Axial neck pain
2- Cervical spondylotic radiculopathy
3- Cervical spondylotic myelopathy

It TCM literature slightly different terms are used. For axial neck pain, the term 'neck type cervical spondylosis' is used. 'Cervical spondylosis of the vertebral artery type' (CS VAT) refers to symptoms of vertebrobasilar insufficiency which may occur due to several reasons. Cervical radiculopathy is referred to as 'cervical spondylosis of the nerve root type.'

2.2.1. Axial neck pain

Axial neck pain is the predominant symptom observed in patients with CS, characterized by pain that is confined to the neck and its adjacent structures, without any accompanying neurological signs or symptoms. This type of neck pain can radiate to several areas, including the medial scapula, chest wall, shoulder region, and head. Headaches are prevalent, occurring in about one-third of patients, and are associated with cervical muscle spasms, typically felt in the sub-occipital area which results in increased tension and reduced blood flow to the impacted area.[37]

A key feature of CS is that neck pain intensifies with movement and is relieved by rest, with symptoms often being more severe in the morning. [38, 39] Quite often the patients cannot exactly pinpoint the source of pain, which may be due to many different aetiologies. Approximately two-thirds of patients with neck pain also experience shoulder pain, which may be unilateral or bilateral. Axial neck pain is frequently caused by disc degeneration, facet joint hypertrophy (although a degenerated disk is more common[28]), osteophytes, and the development of bony vertebral end plates.

2.2.2. Cervical spondylotic radiculopathy

Cervical spondylotic radiculopathy (CSR) involves the mechanical compression and inflammation of cervical nerve roots, primarily those at the C4-C6 levels, where disk degeneration is more common and where the centre of motion for the cervical spine lies. Hypertrophy of the uncovertebral and facet joints may result in compression of the adjacent nerve root and the vertebral artery. [40, 5]

The clinical manifestations of CSR typically adhere to a dermatomal distribution, presenting as cervicobrachial pain, paraesthesia, and, in certain instances, muscle atrophy in the areas innervated by the affected nerve root. [40] It may be caused by either a "soft" hernia, which is common in patients 55 years old or younger, a "hard" hernia, common in patients older than 55 years old.[28,39] It may be acute, subacute, or chronic. Radiculopathy by a "soft" hernia usually is accompanied by motor weakness and/or atrophy and it is quite often acute, while a "hard" hernia often carries sensory symptoms such as paresthesia, hyperesthesia, or

hyperalgesia and is more often related to chronic conditions. When the disease is chronic it usually also carries motor reflex changes.[28,30]

An important distinguishing feature of radicular pain resulting from nerve compression and pain resulting from hypersensitization of the cervical nociceptive neurons in response to facet joint degeneration or disc space narrowing, is the absence of weakness or sensory disturbances, and the fact that the pain from facet joints or narrowing of the disc space is usually bilateral, while cervical radiculopathy may be both unilateral and bilateral.[41]

2.2.3. Cervical Myelopathy

Cervical myelopathy is the result of the compression of the spinal cord due to the degenerative changes of CS. It is less common than the other two types of CS with extreme manifestations that make it easy do recognize. Symptoms of cervical spondylosis with myelopathy include loss of manual dexterity; gait and balance disturbances, especially in the absence of visual cues (Romberg's sign); sensory loss in the hands or feet; arm or hand weakness; defecatory or urinary frequency, urgency, or hesitancy but rarely incontinence. Neck pain and radicular symptoms may also be present. Myelopathy is often associated with spondylolisthesis and is characterized by inflammation and edema of the spinal cord.[29] Given the severity of this condition, a neurosurgical assessment is warranted; thus, it is crucial to refer patients to a medical professional upon suspicion of this disorder.

No studies were found in English that involved Tuina and/or acupuncture. Hence this type of CS will not be addressed in this thesis, however the manifestations and the physical examination that can indicate the presence of CS myelopathy are included here.

CS Type	***Main symptoms***	***Other symptoms***	***Underlying pathology***	***Underlying aetiology***	***Physical diagnostic test***
Axial neck pain	Localized pain in the neck and surrounding structures that worsens with movement and is relieved by rest. Usually worse in the morning Absence of neurological signs is necessary	Pain may radiate to the medial scapula, chest wall, shoulder area, and head (unilateral or bilateral) Occipital headaches	Distortion of the muscles and ligaments, decreased blood flow to the affected side. Sub-occipital muscle spasms due to C1/C2 joint degeneration and subluxation.	disc degeneration, facet joint hypertrophy, osteophytes, development of bony vertebral end plates, soft herniation, atlantoaxial subluxation	Tenderness in the neck, upper back, and shoulders.
Cervical spondylotic radiculopathy	Acute, subacute, or chronic neck pain in combination with radiating upper arm pain and/or weakness/numbness of the upper limb	motor weakness and/or atrophy, paresthesia, hyperesthesias, or hyperalgesias of the affected limb, motor reflex changes	Compression and inflammation of a cervical nerve root (usually between C5-C6-C7, but may involve other levels)	Soft disc herniation (acute) , hard disc herniation (chronic), osteophytes	Spurling's test Distraction test Shoulder abduction (relief) test

Cervical myelopathy	loss of manual dexterity; gait and balance disturbances; sensory loss in the hands or feet; arm or hand weakness;	Frequent or urgent urination/defecation Neck pain Radiculopathy	Inflammation and oedema of the spinal cord	Spondylo-listhesis	L'hermitte's sign Hoffman's sign Finger escape sign Grip and release test

Table 1 – Types of cervical spondylosis with their primary and secondary symptoms, underlying pathologies and etiologies, and physical diagnostic tests.

3. METHODS

3.1. Literature search

To obtain relevant studies the method of internet search was employed. Google scholar (https://scholar.google.com/) was the main search engine used, together with PubMed (https://pubmed.ncbi.nlm.nih.gov/), Semantic scholar (https://www.semanticscholar.org/) and the CNKI database (https://jtp.cnki.net/index/). The terms searched for were 'Tuina', 'Tui Na', or 'acupuncture' in combination with 'cervical spondylosis' and terms relevant to the disease such as 'disk herniation', 'atlantoaxial instability', etc.

3.2. Inclusion and exclusion criteria

The criteria for the study inclusion were set as the following:

- Studies must be published within 2014 to 2024
- Studies should only be in the English language.
- Must be published in a peer reviewed journal.
- Studies should focus on Tuina, Acupuncture, or the combination of both.
- Total sample size should be over 60
- Comprehensive description of treatment methods (e.g. needling techniques, manipulations, treatment duration, etc.) should be included

Exclusion criteria are:

- Not complying with the above
- Studies focusing on specialized techniques (laser-acupuncture, FSN acupuncture etc.)

4. RESULTS AND STATISTICAL ANALYSIS

4.1. Composition Of Studies

4.1.1. Tuina Studies

In total, there were 4 studies centered on Tuina. 1 of them dealt with cervical spondylotic radiculopathy, 1 with cervical disk herniation and 2 with cervical spondylosis of the vertebral artery type.

4.1.2. Acupuncture Studies

Regarding acupuncture as the main treatment, either alone or in combination with other methods, a total of 12 studies were found. Of these, 7 investigated cervical radiculopathy, 1 CS of the vertebral artery type, while 1 mentions cervical spondylosis in a general way. 3 of the studies addressed CS of the neck type.

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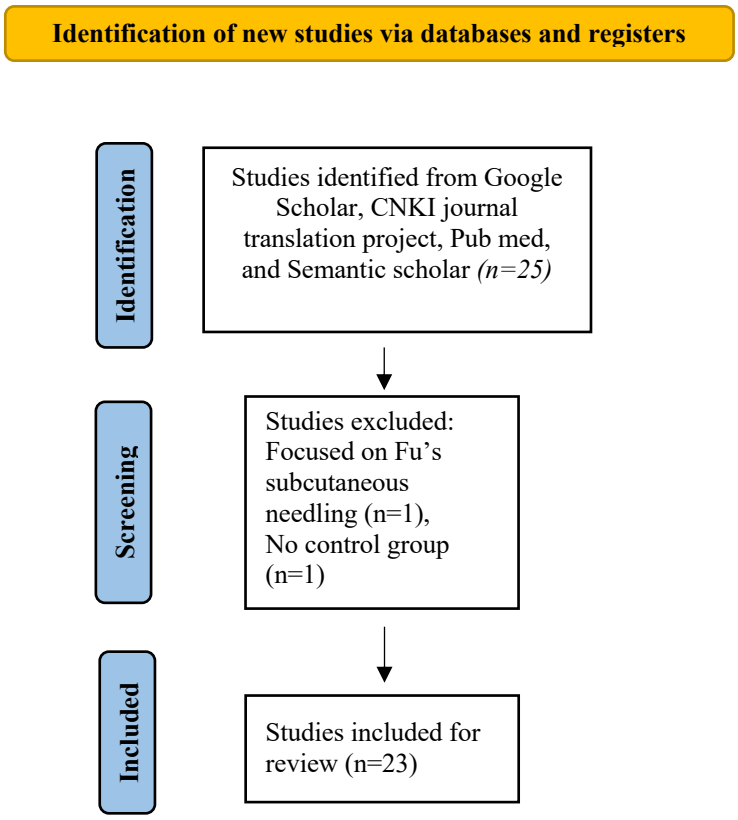

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

4.1.3. Studies including Tuina and Acupuncture

Research produce seven studies combining Tuina with acupuncture. One focused on CS of the vertebral artery type, three on cervical radiculopathy, one on atlantoaxial instability, and two mentioned no specific type.

4.1.4. Analysis according to subject

Studies focusing on CS radiculopathy were predominant, being eleven (47.8%), followed by CS of the vertebral artery type which were four (17.4%), and CS of the neck type together with those referring simply to cervical spondylosis were three (13%) each. Details are found in Table 1.

CS Type	Subject categories			
	Tuina	Acupuncture	Tuina and Acupuncture	
Radiculopathy	1	7	3	11 (47.8%)
Vertebral artery type	2	1	1	4 (17.4%)
CS		1	2	3 (13%)
Neck type		3		3 (13%)
Disk herniation	1			1 (4.3%)
Atlantoaxial instability			1	1 ((4.3%)
Total	4 (17.4%)	12 (52.2%)	7 (30.4%)	23 (100%)

Table 1. Distribution of literature according to subject matter

4.1.5. Therapeutic assessment tools

Among the twenty-two studies reviewed, the predominant evaluation method employed was the total effective rate, which was utilized in twenty of these studies to assess the rate of improvement. This method occasionally incorporated three or four scales of improvement, aligned with the diagnostic criteria and therapeutic effects outlined in traditional Chinese medicine. Typically, it combined both the subjective perceptions of patients regarding their improvement and objective evidence, depending on the research focus. The four scales included: Recovery/cured, indicating that patients were largely symptom-free; Remarkable improvement, where symptoms had significantly diminished; Effective, denoting some degree of relief; and Non-effective, where no treatment effect was observed. The second most frequently used evaluation method was the Visual Analog Scale (VAS), applied in seven of the studies, followed by the Neck Disability Index (NDI), which appeared in five studies. Additionally, one study each utilized the cervical vertigo and functional assessment scale, the Evaluation Scale for Cervical Vertigo (ESCV), the Short-form McGill Pain Questionnaire

(SF-MPQ), and the Tanaka Yasuhisa Scale. Furthermore, one study assessed improvements in sleep quality using the Pittsburgh Sleep Quality Index (PSQI).

The application of biomarkers was similarly minimal. In detail, two studies assessed serum inflammatory factors, two others measured serum concentrations of Endothelin and Calcitonin gene-related peptide, and two studies investigated the changes in vertebral artery blood flow.

4.2. Statistical analysis

4.2.1. Methods of data extraction

After search completion, the literature was divided into three categories. Studies focusing on Tuina, Acupuncture, and the combination of Tuina and Acupuncture. After this was done the study information *(Author, Year, Title, Sample Size, No. of groups, Control method, Tuina Protocol, Duration of Tuina protocol (min), Frequency, Total duration (no. of treatments), Acupuncture points, Acupuncture method, Needle retention (min), Frequency (times per week), Duration (weeks), Total treatments)* as well as the result-related data *(Total effective rate (%), cervical vertigo and functional assessment scale, etc.)* were entered in MS Excel in order to make calculations and comparisons.

4.2.2. Analysis According to Total Effective Rate (TER)

Only three out of the four studies focusing on Tuina used the total effective rate as an assessment tool. The highest TER was scored by Fan[42] at 96.7% and the lowest by Zhao[43] at 90%. Details are presented in Table 2.

Author	**CS type**	**TER**	**Control TER difference**
Fan[42]	Vertebral artery type	**96.7%**	**13.4%**
Wen[44]	Intervertebral disc herniation	**92.4%**	**11.4%**
Zhao[43]	Vertebral artery type	**90%**	**20%**
Average		**93%**	**14.9%**

Table 2. TER of the studies using Tuina as a primary approach ranked according to TER

From the studies focusing on acupuncture, one did not include a TER score. Of the remaining eleven, five of them were upwards of 96.9%, while the remaining six moved downwards starting from 93.6% with the lowest being 78.1%. The five studies with the highest scores are presented in Table 3.

All of the research using the combined approach of Tuina and Acupuncture yielded a TER of over 90%, but only half (three studies) reported a TER over 96.9%. TER scores of the studies using acupuncture and Tuina are presented in Table 4.

Author	**CS type**	**TER**	**Control TER difference**
Sun[45]	Radiculopathy	**98.3%**	**16.6%**
Wu[46]	Radiculopathy	**98.1%**	**10.6%**
Li[47]	Radiculopathy	**97.6%**	**14.6%**
Zhao[48]	Radiculopathy	**97.1%**	**14.2%**
Song[49]	Axial neck pain	**96.9%**	**15.6%**
Average		**93.5%**	**12.5%**

Table 3. Studies with the highest TER using acupuncture as a primary approach

Author	**CS type**	**TER**	**Control TER difference**
Wang[50]	Radiculopathy	**100.0%**	**14.7%**
Pan[51]	Radiculopathy	**97.10%**	**8.5%**
Ma[52]	Atlantoaxial instability	**96.9%**	**34.4%**
Xu[53]	Vertebral artery type	**93.3%**	**16.6%**
Zhu[54]	Radiculopathy	**91.7%**	**25%**
Ying[55]	Cervical spondylosis	**91.48%**	**23.5%**
Average		**92.7%**	**21.1%**

Table 4. Studies using the combination of Tuina and acupuncture as a primary approach

The studies with the highest TER from all three categories are presented in Table 5.

Author	CS type	TER	Category
Wang[50]	Radiculopathy	**100.0%**	Tuina with acupuncture
Sun[45]	Radiculopathy	**98.3%**	Acupuncture
Wu[46]	Radiculopathy	**98.1%**	Acupuncture
Li[47]	Radiculopathy	**97.6%**	Acupuncture
Zhao[48]	Radiculopathy	**97.1%**	Acupuncture
Pan[51]	Radiculopathy	**97.10%**	Tuina with acupuncture
Ma[52]	Atlantoaxial instability	**96.9%**	Tuina with acupuncture
Song[49]	Axial neck pain	**96.9%**	Acupuncture
Fan[42]	Vertebral artery type	**96.7%**	Tuina

Table 5. Top 9 studies with the highest TER among the three categories.

The studies among the three categories, with the biggest difference in TER between the observation and control groups, and their control methods are shown in Table 6.

Author	CS type	% of difference	Control Method	Category
Ma[52]	Atlantoaxial instability	**34.4%**	Flunarizine Hydrochloride	Tuina with acupuncture
Zhu[54]	Radiculopathy	**25%**	Tuina	Tuina with acupuncture
Ying[55]	Cervical spondylosis	**23.5%**	Tuina	Tuina with acupuncture
Zhao[48]	Vertebral artery type	**20%**	Flunarizine Hydrochloride	Tuina
Xu[53]	Vertebral artery type	**16.6%**	Warm-needling moxibustion	Tuina with acupuncture
Sun[45]	Radiculopathy	**16.6%**	Acupuncture	Acupuncture

Table 6. Top 6 studies from all three categories ranked based on the TER difference between observation and control groups

4.2.3. Analysis of control methods

An investigation into the frequency of the most commonly encountered control methods, resulted in finding out that acupuncture, used one way or another, was employed as a control method is approximately half of the literature (52.2%) followed by the use of medication (most commonly flunarizine hydrochloride) (26%) and Tuina (17.4%). Details are presented in Table 7.

Control method	Frequency	Frequency %
Acupuncture	**13**	**56.5%**
Medication	**6**	**26%**
Tuina	**4**	**17.4%**

Table 7. Frequency of the most common control methods used in literature

4.2.4. Analysis of acupuncture points according to body areas

The most frequently used acupoints in the head and neck area were the neck-jiaji points (9), followed by Fengchi GB20 (7), and Dazhui GV14 (6), with Baihui GV20 and Fengfu GV16 being used an equal amount of times (5).

Points found most common on the shoulder and arm were Hegu LI4, Waiguan SJ5, and Houxi SI3 (4), followed by Jianjing GB21, and Neiguan PC6 (3). For the rest of the body Geshu BL17 was the most frequently used point (5).

Details about the frequency of points can be found in Tables 8, 9, 10.

Points	Frequency	Rate
LI4	4	**17.4%**
SJ5	4	**17.4%**
SI3	4	**17.4%**
GB21	3	**13.0%**
PC6 (PC7)	3	**13.0%**
LI15	1	**4.3%**
LI14	1	**4.3%**
LI11	1	**4.3%**
LI10	1	**4.3%**
Wailaogong	1	**4.3%**

Table 8. Points in the shoulder and arm area

Points	Frequency	Rate
Jing jiaji	9	**39.1%**
GB20	7	**30.4%**
GV14	6	**26.1%**
GV16	5	**21.7%**
GV20	5	**21.7%**
BL10	3	**13.0%**
Ahsi points	3	**13.0%**
Gongxue	2	**8.7%**
BL11	1	**4.3%**
GB12	1	**4.3%**
SJ17	1	**4.3%**
Jing Bailao	1	**4.3%**
Taiyang	1	**4.3%**
Yintang	1	**4.3%**
GV21	1	**4.3%**

Table 9. Points on the head & neck area

Points	Frequency	Rate
BL17	5	**22%**
BL18	2	**9%**
ST40	2	**9%**
ST36	2	**9%**
SP6	2	**9%**
GV3	2	**9%**
BL26	2	**9%**
GB39	1	**4%**

Table 10. Points on the rest of the body

4.2.5. Analysis of Needling Techniques On The Cervical Jiaji Points

All of the nine studies that used the neck Jiaji points had differences in the needling techniques used. Wu[46] avoided a deep penetration and chose the even method of manipulation for cervical radiculopathy, similarly to Zhu[54] who needled the point 30 degrees lateral to the spine, to a depth of 1.3 cm and chose a reducing manipulation to treat CS of the

vertebral artery type. Li[47] treating CS of the neck type, preferred a straight penetration to a depth of 0.8 cun, with even stimulation. In contrast to the previous, Zhao[48] used Gao's nape needle technique, in which the needle is required to touch the periosteum of the vertebral lamina, and a strong de qi sensation was preferred on needling (local numbness, electricity, heaviness, etc.). Similarly, in Qihuang needle therapy applied by Yang,[56] a deep insertion (25-35mm) and a specific manipulation causing a distinct de qi sensation was employed.

Two researchers used moxa together with acupuncture. Ying[55] used a moxa stick over the needles, after using an oblique puncture with an even method of stimulation, while Pan[51] used warm-needling moxibustion and also punctured the points to the extent that the patient feels soreness, in CS radiculopathy patients.

Only one study by Zhu[54] used EA on the neck Jiaji points. Sun[45] used the "setting fire on the mountain" needle manipulation on C7 Jiaji before needling the C4-C6 points using an even method and pressing the needle pole after removal.

Details are presented in Table 11.

Author	CS type	Needling method	Needle size
Wu	Radiculopathy	Not too deep (0.5-1.5 cun), Even method	0.25x40mm
Zhu	Vertebral artery type	30° lateral to the spine, 1.3 cm deep, reducing twirling and rotating	0.25x25-40mm
Li	Neck type	Straight, 0.8 cun, Even method (for 1 min. every 10 minutes)	0.25x40mm
Zhao	Radiculopathy	'Gao's nape needle', Deep needling, needle needs to touch the periosteum of the vertebral lamina, strong de qi preferred)	0.25x50mm
Ying	Cervical spondylosis	Oblique puncture, even method, Moxa stick above the needle for 15 min.	-
Pan	Radiculopathy	Warm-needling moxibustion (3 moxa cones per point), depth to extent that the patient feels soreness	0.25x40 mm
Yang	Radiculopathy	'Qihuang needle therapy', 2.5-3.5 cm depth according to patients body	0.5x40mm
Sun	Radiculopathy	'Setting fire on the mountain' for C7, C4-C6 perpendicular, even method	0.30x40mm
Zhu	Radiculopathy	First even method for 2 min. followed by EA	0.30x25-40mm

Table 11. Needling methods of the neck Jiaji points

4.2.6. Analysis According to Treatment Frequency, Duration and No. Of Total Treatments

The minimum, maximum, and average treatment frequency, and duration as well as the total number of treatments were calculated. For acupuncture the average value for the duration of treatments was 2.5±0.88 weeks (minimum: 1, maximum: 4) with a frequency of 4.6±0.79 times per week (min: 3, max: 5), and for 13.4±7.35 (min: 5, max: 36) total treatments. For

Tuina the average duration of treatment was 2.8±1.03 (min: 1, max: 4), with a frequency of 4.3±1.41 (min: 3, max: 7), for a total of 15.4±9.31 (min: 5, max: 36) treatments. Details are presented in Table 12.

	Acupuncture			**Tuina**		
	Frequency (per week)	Treatment Duration (weeks)	No. of treatments	Frequency (per week)	Treatment Duration (weeks)	No. of treatments
Average	4.6±0.79	2.5±0.88	13.4±7.35	4.3±1.41	2.8±1.03	15.4±9.31
Shortest	3	1	5	3	1	5
Longest	5	4	36	7	4	36
Most common (times appearing)	5 (12)	2 (8)	10 (4)	3 (4)	4, 2 (3)	14 (3)

Table 12. Treatment regime

5. QUALITATIVE ASSESSMENT

5.1. Qualitative Assessment

In order to estimate the validity of the results provided by the literature reviewed, an overall assessment of the methodological quality of the studies is in order. To that end, the PEDro scale[57] was used. It has been found particularly reliable[58] to assess the clinical applicability for the results of physiotherapy studies. For the use of this scale there are normally two raters employed however due to the circumstances regarding this paper, a single rater was employed.

A score of 4-5 is considered fair, while a score of 6-8 is considered good, and 9-10 excellent, with the optimal score being 8/10.[58] The average score of all studies was 6.14±1.01 which would land between fair and good. The lowest score was 5 and was given in three studies, while only two studies scored above 6 (one scored 8, and one scored 10). The main reason that points were lost had to do with the blinding of participants, therapists, and evaluators, which is something to be expected due to the nature of the majority of the interventions, which renders blinding difficult, if not impossible. Additionally, in many of the studies details about the randomization procedures were not clarified, and that the allocation methods in several instances were not being mentioned.

Factors limiting the general validity of the results are the relatively small sample sizes (mean 96.45±66.36) although as can be seen by the SD, the sample size varied considerably among studies, the mean sample size is still considered small. This highlights the need for larger scale studies in order to enhance the validity of the results concerning Tuina and acupuncture therapy. Only one study included a one-month follow-up, with the rest of them having a 3-week maximum duration of treatment. Furthermore, no study included any form of placebo or sham acupuncture. Considering all of the above it seems that overall the studies included here ranged from between a fair and moderate quality.

6. DATA SYNTHESIS AND OBSERVATIONS

6.1. Tuina

6.1.1. Improvements in headache, dizziness and vertigo

In CS patients, symptoms such as dizziness and vertigo are linked to dysregulation blood flow in the vertebrobasilar arteries**.** Two studies used Transcranial Doppler Sonography to measure blood flow changes. Xu et al. demonstrated that the combination of the Kai Qing Long Suo technique with warm-needling moxibustion was more effective than warm-needling moxibustion alone in alleviating symptoms associated with vertebrobasilar insufficiency, which include headaches, tinnitus, and dizziness.[53] Fan et al.[42] used a pulling type of manipulation to correct displaced vertebra which proved more effective than flunarizine hydrochloride in improving vertebrobasilar artery blood flow, Neck Disability Index (NDI) scores and scores on cervical vertigo symptom and functional assessment scales. Notably, the improvement in mean blood flow velocity was more pronounced than in the previous study, likely due to the absence of manipulation or cervical vertebra correction in that study, which relied solely on acupuncture and soft tissue manipulation. The chiropractic manipulation exhibited a slightly higher total effective rate (TER) of 96.7% compared to 93.3%. However, there was a significant difference in the percentage of patients reporting recovery, favouring the combination of Kai Qing Long Su with warm-needling (76.7% versus 66.7%). A third study in this type of patients by Zhao et al.[43] used a method that combined Rou Fa, Na Fa, An Fa, with Bashen Fa alongside a herbal fumigation machine and found it more effective than flunarizine hydrochloride in terms of TER and NDI scores. Although this study reported the lowest TER (90%) and recovery rate (50%) among the three, it offered valuable insights into the potential mechanisms underlying improvement by measuring endothelin (a potent vasoconstrictor) and Calcitonin Gene-related Peptide, which indicated a decrease and an increase, respectively. This suggests that the treatment may influence the humoral environment surrounding the targeted areas.

6.1.2. Effects on atlantoaxial instability and cervical disk herniation

Wen et al.[44] conducted a study involving 158 patients diagnosed with cervical disk herniation, predominantly affecting the C5-C6-C7 levels. The research aimed to evaluate the efficacy of intensive stimulation of tender points in comparison to meloxicam for alleviating symptoms such as dizziness, pain, heaviness, and numbness in the neck, back, and arms. The intervention primarily consisted of identifying sensitive trigger points in the neck and shoulder regions, applying thumb pressure with gradually increasing intensity for durations of 15 to 30 seconds at each point. The results indicated that this method surpassed the effects of meloxicam, significantly reducing the Visual Analog Scale (VAS) score to a notably low value of 2.06.

In a separate study involving 64 patients exhibiting imaging-confirmed atlantoaxial vertebra deviation, who presented with symptoms including muscle tension, dizziness, occipital pain, nausea, vomiting, and sweating, Ma et al.[52] combined ulna-tibia needling therapy with the "one point-two surface" Tuina manipulation to address the deviation. The TER was remarkably high at 96.9%, with an 88% recovery rate. Additionally, there was a substantial improvement in the main symptoms and physical signs when compared to flunarizine hydrochloride. Notably, the technique resulted in an alteration of the atlantoaxial axle

separation degree by 80% or more in 26 out of 32 patients (81.25%), as confirmed through X-ray analysis.

Wei et al. [59] implemented a manipulation technique aimed at adjusting the atlantoaxial joint, in conjunction with a lumbosacral adjustment. This approach also incorporated the Governor Vessel-unblocking and yang-regulating needling method, which targeted specific points in the lumbar region (GV3 and BL26) as well as points determined by syndrome differentiation. Following a series of ten treatments, the results indicated a more significant improvement compared to acupuncture alone; however, the total effective rate (TER) of 78.1% was the lowest among the studies reviewed. Notably, this study also reported the highest proportion of non-effective cases, at 21.8%.

6.1.3. Effects on Cervical Radiculopathy

The sole investigation that incorporated follow-up assessments was conducted by Cui et al.[60] where they compared Shi-style cervical manipulation (SCM), with mechanical cervical traction (MCT) for a total of 6 treatments. Follow-up was performed at 2, 4, 12, 24 weeks after. Statistical analyses of various indices indicated that SCM demonstrated superiority over MCT up to certain time points, specifically at 24 weeks for the NDI and 12 weeks for the VAS, after which the effects of both treatments were comparable. No significant differences were noted in the improvement of quality of life between the two treatment modalities.

Furthermore, electroacupuncture (EA) combined with Tuina was found to be more effective than Tuina alone in alleviating cervical radiculopathy. The methodology employed by Zhu et al.[54] included acupuncture points based on syndrome differentiation. Although compared to other studies the percentage of recovered cases was low (25%), the percentage of cases with remarkable improvement was substantial (41.7%). The most successful study with 100% TER was performed by Wang et al.[50] which combined Tuina with auricular point-sticking.

6.2. Acupuncture

Numerous techniques have been documented in the acupuncture literature. Gu et al. [61] applied the seven acupoint-penetrating needles method to patients with cervical spondylosis, based on the principle that "shaoyang governs bone." This approach involved needling a combination of distal and local points, specifically targeting the GB/SJ meridians and the Du mai, with the exception of SP6. Compared to needling points on the head combined with traction this method proved also more efficient in relieving symptoms, improving the NDI, besides the VAS scores between the two groups being the same after treatment. Similarly, Lin et al.[62] investigated the effectiveness of a standard set of points (GV14, EX-B-2, and SI3) against needling at PC-6 Neiguan, followed by pricking the blood vessels on the fingerprints, in patients primarily experiencing neck pain. No significant differences were observed between the two treatment protocols immediately after the intervention or at various follow-up intervals. This study underscores the potential effectiveness of distal points, which may be particularly relevant for patients who exhibit hypersensitivity in the neck area or who may be hesitant to receive treatment directly on the neck. A related observation is made in another investigation. Li et al.[47] employed wrist-ankle acupuncture and moxibustion targeting specific points on the neck and upper back (GV14, Jing Bailao), complemented by the application of an herbal compress. Similar to Zhao et al.[48] previously, a drop in endothelin-1 and an increase in Calcitonin Gene-related peptide were noted, suggesting an improved blood flow regulation.

In cervical radiculopathy patients, Wu et al.[46] implemented a distinct approach involving superficial puncturing of the Jingjiaji points, followed by the application of an herbal preparation to the punctured sites. Despite achieving a high therapeutic efficacy rate (TER) of 98.1%, this method necessitates extensive preparation of the herbs, rendering it somewhat impractical within a Western Chinese medicine clinic setting. For Qi stagnation and blood stasis radiculopathy Zhao et al.[63] conducted a comparative analysis of ibuprofen, mecobalamin, and flunarizine hydrochloride against Gao's nape needling and Shentong Zhuyu decoction, focusing on their impact on inflammatory markers in addition to their symptom-relieving capabilities. The integration of acupuncture and moxibustion proved to be more effective than medication in alleviating symptoms and reducing pro-inflammatory cytokines such as TNF-α, IL-6, and IL-10. Furthermore, this study highlighted the selection of distal points on the affected side (e.g., LI11, LI10, SJ5) and the combination of electro-acupuncture (EA) with manual acupuncture, utilizing specific points (GB20 and Gongxue) linked to an EA device.

Yang et al.[56] conducted research on Qihuang needle therapy, which involved minimal retention during needle manipulation. Although this technique recorded the lowest TER among all acupuncture studies at 85.7%, it demonstrated the most significant improvement in Visual Analog Scale (VAS) scores, decreasing from 6.36 pre-treatment to 1.13 post-treatment. Additionally, it showed notable enhancements in the Tanaka Yasuhisa cervical spondylopathy scale. This approach offers certain advantages, such as utilizing only six needles and having virtually no retention time, making it particularly suitable for elderly patients with diminished qi, thereby allowing for extended therapy sessions.

Another method for cervical radiculopathy was the "setting fire on the mountain method" developed by Lu Shou-Yan and researched by Sun et al[45]. This method targets the cervical Jiaji points and aims to enhance yang qi, eliminate yin cold, and address deficiencies. Thermographic observations indicated a more significant increase in local temperature compared to even manipulation, suggesting its suitability for conditions characterized by yang deficiency or cold patterns. Among all acupuncture techniques studied, this method achieved the highest TER at 98.3%, with a considerable number of patients reporting significant therapeutic effects.

In patients with liver blood deficiency, manifesting dizziness and vertigo, Zhu et al.[64] added BL17 and BL18 to the cervical Jiaji points to regulate the liver and tonify the blood, a method which proved more efficient than just the Jiaji points alone, although it should be noted that patients in this study were 34.1±3.5 years of age.

Thumb-tack needling, a technique involving the insertion of small intradermal needles at acupoints for extended periods, was the preferred approach utilized by Zhao et al.[48] The methodology for selecting acupoints diverged from that employed in other research. Tender points were identified by palpating ST9, SJ16, BL10, LI18, GB20, and SI16, after which the luo-connecting points of the affected meridians, along with their corresponding exterior-interior meridian points, were also needled (for instance, if ST9 was tender, both ST40 and SP4 were included in the treatment). In comparison to thumb-tack needling at more commonly utilized points such as BL10, GB20, GB21, and LI4, this approach yielded superior outcomes across all three assessments, establishing it as one of the most effective methods included.

As far as neck pain, besides the study using PC6 and fingertip bleeding, two more studies were found. Li et al.[47] wanted to compare the effect of different degrees of stimulation on patients with neck pain. This was achieved by using different needle thickness (0.25x40mm to 0.18x40mm) as well as longer and stronger needle manipulations. In the NDI, SF-MPQ, VAS scale, and TER the stronger stimulation did better, although both methods produced results. While this finding was anticipated, it does not imply that weaker stimulation lacks

efficacy; rather, it may require a longer duration to achieve optimal therapeutic results. Consequently, weaker stimulation techniques should not be dismissed, particularly for patients who are frail or highly sensitive.

Another method was the Jin Gou Diao Yu (gold-hook-fishing) acupuncture method[49] on Ahsi points on the sides of the cervix and the shoulder. Compared with the twirling-reducing method this method was better in both the NDI, MPQ and had one of the highest TER (96.9%) of all studies. The benefit of this method is that it is quite simple to use, uses standard needle thickness, and does not require deep needling. Of note, patients in this study were between 20-40 years old.

Table 4 – Tuina operating procedures

Author, year	***Name/Type of Method***	**Operation**
Wang, 2014		Rou-kneading, Gun-rolling, Na-grasping and Cuo-twisting methods were used in this study. Major acupoints: Fengchi (GB 20), Jianjing (GB 21), Jianwaishu (SI 14), Jianyu (LI 15), Quchi (LI 11), Shousanli (LI 10) and Hegu (LI 4). First, apply 3-minute Rou-kneading to Fengchi (GB 20), Jianjing (GB 21), Jianwaishu (SI 14), Jianyu (LI 15), Shousanli (LI 10) and Hegu (LI 4); then stand behind the patient and apply 10-minute Gun-rolling to the shoulder, using the force of 4 kg and frequency of 120 times per minute; finally, apply 3 times of Na-grasping to the back of neck and bilateral Jianjing (GB 21).
Ma, 2021	One point – two surface	At the beginning, the tuina manipulations, e.g. kneading, pressing and plucking, were used for 10 to 15 min to relax the tendons and muscles of the neck. Afterwards, the "pointto-surface" manipulation was operated. 1) "One-point and two-surface" method. By taking the axis vertebra dislocated to the left as the example. The patient is in sitting position with the head up for 5° to 10° The operator is standing or sitting position behind the patient. Fixing the lateral side of the second vertebral spinous process (that is the one "point", mostly at the painful point on the junction between the trapezius muscle and skull on the affected side) with the palmar side of the thumb of the left hand, slightly flexing the rest four fingers of the left hand, with the four fingers separated, placing the palmar sides of the fingers on the lateral side of the head of the patient (on the same side as the thumb, one "surface"). From the front of the head, putting the palm of the right hand on the cheek on the opposite side (one "surface"), with the gentle force exerted by the coordination of two hands, pulling the head of the patient to the left side with the right hand to a large range, while pushing the affected vertebra to the contralateral direction with the left thumb and exerting a gentle force with the rest four fingers coordinated with the head movement. Generally, a "click" sound is presented, indicating the correction of joint and the success of manipulation. For the axis vertebra dislocated to the right side, the manipulation is same, but in an opposition direction. 2) "Up and down lateral pressing" method. By taking the axis vertebra dislocated to the left as the example. The positions of the operator and the patient are same as (A). Extending the index finger, the middle finger, the ring finger and the small finger of the right hand, with the finger tips upwards, placing the right hand on the right upper of the patient's head and pushing and pressing downward to the left lower direction. Simultaneously, pushing the second cervical spinous process with the operator's left thumb from the left to the right. Generally, a "click" sound is presented, indicating the success of manipulation. For the axis vertebra dislocated to the right side, the manipulation is same, but in an opposite direction. 3) "Lifting and trembling" method. This method is applicable for the dislocation to the either side. The patient sits in a low bench. The operator sits or stands behind the patient. The patient is required to slightly low the head and the occiput and the back of the patient are tightly leaned on the chest of the operator. The operator flexes the elbow joint and ensures the patient's head on the elbow joint. Lifting while trembling is exerted in high frequency and small amplitude for over 10 times to restore the dislocated atlantoaxial joint. For the patients with the successful restoration and correct joint position maintained (judged by the improvements in the symptoms and physical signs), only relaxation manipulations of tuina were given, once a day, for 5 times in total.

Table 4 – Tuina operating procedures

Fan, 2021		Took C1 left-posterior rotation displacement for example. The patient took a supine position, with the neck relaxed, and hands relaxed on both sides of the body. The doctor stood to the patient's head, facing the patient. Firstly, applied An-pressing and Rou-kneading manipulations for 3-5 min to relax the neck soft tissue. The doctor squatted slightly to the left of the patient's head. The left forefinger pulp of the doctor was placed on the rear of C1 transverse process. The middle finger and ring finger were slightly bent and closely attached to each other. The thumb and palm supported the occipital bone. The right hand palm was gently placed on the patient's right forehead or temporomandibular jaw. With both hands flexing the neck by about 15° and rotating to the right at an appropriate angle, the doctor's left forefinger felt the small joint activity. When the forefinger felt resistance, a small swift force was given toward the patient's nose tip. Often a 'click' sound could be heard, indicating the success of adjustment
Xu, 2019	Kai Qing Long Suo	Qing Long Suo is located in the trapezius muscle at the neck-shoulder junction, one on the left and one on the right. It is known as 'well lock' or 'shoulder tendons'. Unlocking method: The patient took a sitting or a prone position. The doctor sat or stood behind the patient with his feet apart. The doctor stood ordinarily (when the patient took a sitting position) or took horse-riding squat (when the patient took a prone position). The 'butterfly manipulation' was used, that is, four fingers folded together and slightly flexed, opposite to the thumb. The trapezius muscle was pinched with the lateral edges of the index finger and the thumb (Figure 1). According to the patient's endurance, it can be lifted vigorously. Strength should increase gradually and the movement should be gentle. The two sides should be operated simultaneously for 15-20 min, once a day, 7 treatments as a course. The curative effect was observed after one course of treatment.
Wen, 2015		Location of tender points: Beginning point of trapezius; attachment points of multifidus and spinal rotators of the affected vertebrae; attachment points of splenius capitus and semispinalis capitus at laminae of cervical vertebrae; the endpoint of musculi levator scapulae; trapezius between neck and shoulder[5-6]. Operation and key points: The tender points were pressed by the tip of the thumb with the thumb and index finger of the operator opposed to each other, and the force should be increased gradually but within the patient's tolerance to reach the profound layer of the muscles. The force should be performed perpendicularly to the muscles, tendons or nerves, with a rhythmic pause. The treatment lasted 15-30 s for each tender point. While with the increased treatment sessions and decreased pain intensity, the treatment time for each tender point could be shortened but no less than 15 s
Zhu, 2014		The soft tissues were relaxed by An-pressing and Rou-kneading, Na-grasping and Rou-kneading, and Gun-rolling manipulations. The patient took a sitting position and the practitioner stood behind the patient's side. First, the neck muscles and area lateral to the spinous processes were Rou-kneaded (Figure 1), then the muscles of the neck and shoulder were Na-grasped and Rou-kneaded

Table 4 – Tuina operating procedures

		(Figure 2), and then the muscles of the neck and back were Gun-rolled and Rou-kneaded (Figure 3). Finally, tender spots of the spinous processes were An-pressed and Tanbo-plucked. The relaxing method lasted for 10-12 min. The Duanti-lifting method in an upright sitting position: After the patient took an upright sitting position, the practitioner held the patient's jaw by the two sides or occipital part and jaw with the two hands respectively, to pull upward forcefully or bend forward and extend backward, with the two thumbs pressing on Fengchi (GB 20) continuously for about 5 min (Figure 4). The rotating reduction at fixed points in a sitting position: After the patient took an upright sitting position, the practitioner stood behind the patient, and located the position of the deviated spinous process with the thumb, and then pulled the patient's head and chest close to the chest of the practitioner. Then the practitioner pressed and held up against the right side of the deviated spinous process with the thumb of the left hand, with the rest four fingers adhered to the left side of the neck, and asked the patient to bend the neck forward. The practitioner flexed the right elbow joint and held the patient's jaw with the forearm and elbow fossa, and guided the patient to rotate the neck toward the sick side while giving a vertically pulling and extending force on the patient's neck. When the muscles of the patient's neck were relaxed, under the coordination of the practitioner's manual operation, the practitioner first lifted and upheld the hand holding the patient's jaw, and suddenly increased the rotation amplitude of the neck, with the thumb of the left hand pushing the articular process upward and outward for immediate reduction (Figure 5).
Zhao, 2014		Three-step tuina manipulation Step 1: Relaxation by Rou-kneading and Na-grasping manipulations. With a prone position of the patient, the practitioner applied 10-minute thumb Tui-pushing (Yi Zhi Chan), Gun-rolling, Rou-kneading and Na-grasping manipulations to patient's nape, shoulder and upper back; then applied digital An-pressing or Rou-kneading to Jianjing (GB 21), Tianding (LI 17), Tianzong (SI 11) and Ashi point, 1 min for each point; and finally, applied Na-grasping to cervical Jiaji (EX-B 2) points, Fengchi (GB 20) and Jianjing (GB 21), 1 min for each point Step 2: Regulation by Bashen-pulling. With a supine position of the patient, the practitioner placed the overlapped hands over the patient's C3, C4 and C5, gently lifted the patient's neck to pull and stretch (from top to bottom) at an angle of approximately 15° for no less than 1 min, using area between spinous processes as the origin of force, and repeated this for 5 times; then supported the patient's mandible with one hand, and lifted the neck with the other hand to stretch and allow a lateral flexion of 5-8°, once to the left and once to the right. Step 3: Finish up along the meridians. With a supine position of the patient, the practitioner applied Tui-pushing (with the finger pulps of both hands) along the Governor Vessel and Bladder Meridian (from bottom to top) alternately, 5 times for each line (Figure 7); then applied parting Tui-pushing to forehead and face 5 times (Figure 8) and Na-grasping to five meridians from the anterior hairline, 5 times on the left and 5 times on the right (Figure 9); finally applied An-pressing and Roukneading to Taiyang (EX-HN 5), Yintang (GV 29), Yangbai (GB 14) and Baihui (GV 20), 1 min for each point (Figure 10)

Table 4 – Tuina operating procedures

Wei, 2015		Before the manual techniques, it was necessary to massage the local areas to relax the muscles. The reduction technique was used after the first treatment. Afterward, in the manual palpation to touch the spine at the fifth and tenth treatment, the reduction technique was used again to set the spine, if the abnormality was palpated. The fine adjustment technique for the upper neck section, proposed by Prof. Shen Guo-quan, was applied to reposition the atlantoaxial vertebra. After the patient took a lateral recumbent position, with the spinous process of C1 upward, the practitioner stood behind the patient and pushed the lateral side of the patient's opposite temple with the other palm. The practitioner slowly flexed the patient's head with the palm passively for about 15°, in sensing the patient's muscles were relaxed, and suddenly enlarged the lateral flexion of the patient's head by an amplitude of 3-5° with coordination of the practitioner's technique, and at the same time pushed the transverse process of the protruding atlantoaxial vertebra with the thumb. After the operation, the reposition was confirmed by palpation. The lateral Ban-pulling technique for repositioning the lumbosacral vertebrae, proposed by Prof. Wei Yi-zong, was applied to reposition the lumbosacral vertebrae[4]. After the patient took a lateral recumbent position, with the above lower limb on the flexed hip joint, the practitioner stood facing to the patient and held the upper part of the patient's anterior armpit with one hand, and put the ular side of the flexed elbow of the other hand near the sacroiliac joint of the patient's hip, to make a small amplitude to shake the lumbosacral region, and released the strength in opposite direction instantly and simultaneously by the two hands when sensing the patient's muscles were relaxed, for forming a shear force at the lumbosacral joint. After the operation, the reposition was confirmed by palpation.
Cui, 2017		Shi-style cervical manipulations 1. Soothing tendon step. The therapist kneaded the patient's neck, grasped the back and waist in turn, and rolled the upper limbs; repeated 3 to 6 times. 2. Osteopathic step. The therapist lifted the patient's head gently, relaxed the neck by turning the head in flexion, extension, right (45°), and left (45°); repeated 3 to 6 times. Then, pulling manipulation was applied to the neck joint if no discomfort was reported by the patient. 3. Dredging collateral step. The therapist held the hands of the patients with gentle and fast force at full tilt for continuous small amplitude jitter for 6 times, and twisted on sensitive points of the ears for 30 s. The last step was rubbing manipulation of the acupoints GV 4, GV 14, GV 17, GV 20, each for 30 s.

Table 5 – Supplementary methods to Tuina operations

Author, year	***CS pathology***	***Name/Type of manipulations***	***Supplementary method***	***Supplementary method operation***
Wang, 2014	Radiculopathy	Standard Tuina manipulations	Auricular point sticking	Major points: Cervical Vertebrae (AH13), Liver (CO12), kidney (CO10), Shenmen (TF4) and Subcortex (AT4). Adjunct points: Positive reaction points within the scapha scanned using a probe. The magnetic seeds were used for two ears alternately and exchanged once every other day. The patients were asked to press 2-3 times a day, 3-5 min each time until the occurrence of sore, distending, warm or radiating sensation.
Ma, 2021	Atlantoaxial instability	One point-two surface method	Wrist-ankle acupuncture	The zone of cutaneous region of hand taiyang meridian of bilateral ulna region (from the carpal region to the elbow joint). Depth: 30 to 35 mm subcutaneously. One or more needles were inserted. 4 manipulations were exerted, i.e. the “up-and down”, “side-to-side shaking” technique, “side-to-side twirling” technique and “clockwise and counter-clockwise annular shaking” technique
Fan, 2021	Vertebral artery type	Chiropractic adjustment of upper cervical vertebra		
Xu, 2019	Vertebral artery type	Kai Qing Long Suo method	Warm-needle moxibustion /Cupping	GV 20, GV 16, GB 20, Taiyang (EX-HN 5), BL 10, Jingbailao (EX-HN 14), PC 6, cervical Jiaji (EX-B 2) points and Ashi points. GB 20, Jingbailao (EX-HN 14) and cervical Jiaji (EX-B 2) points were attached with moxa balls sized of olive pit, which were then ignited for warm needling moxibusiton. Each acupoint was given 2 moxa balls, and the needles were retained for 20 min. Cupping on the neck was operated subsequently.
Wen, 2015	Intervertebral disc herniation			

Table 5 – Supplementary methods to Tuina operations

Zhu, 2014	Radiculopathy		Electro-acupuncture	GV 14, BL 11, cervical Jiaji (EX-B 2) points and SI 3. Adjunct points: LI 4 was added for wind, cold and damp pattern; BL 17 for pattern of qi stagnation and blood deficiency; ST 40 for pattern of obstruction of collaterals by phlegm and dampness; SP 6 for pattern of insufficiency of the liver and kidney; ST 36 for pattern of deficiency of qi and blood. After the arrival of the needling sensation, the needles were twisted for 2 min by even reinforcing-reducing technique and the patients were demanded to have a numb sensation in the local area. In puncturing SI 3, the needle was penetrated toward LI 4. Then, GV 14 and BL 11 as one group and cervical Jiaji (EX-B 2) points as another group were connected with EA apparatus for continuous 20 min, with continuous wave, 40 Hz frequency and 2 mA current intensity.
Zhao, 2014	Vertebral artery type		Fumigation	Chinese herbal fumigation Ingredients: Rou Gui (Cortex Cinnamomi), Fu Zi (Radix Aconiti Lateralis Praeparata), Chuan Xiong (Rhizoma Chuanxiong), Dan Shen (Radix et Rhizoma Salviae Miltiorrhizae), Ge Gen (Radix Puerariae Lobatae), Yin Yang Huo (Herba Epimedii), Qiang Huo (Rhizoma et Radix Notopterygii) and Hong Hua (Flos Carthami). Method: Soak 10-30 g of above ingredients into cold water for 10 min and heat them in evaporator until steam occurs. Then ask the patient to lie on the back in a multifunctional rehabilitation bed, and expose the neck area to the fumigation hole. With the temperature set between 40 ℃ and 55 ℃, the fumigation lasts for 30 min.
Wei, 2015	Chiropractic adjustment of upper cervical vertebra		Governor Vessel-unblocking and yang-regulating acupuncture	GV 20, GB 20, GV 16, GV 14, SI 3, GV 3 and BL 26. Adjunct acupoints: BL 24 was added for serious low back pain; ST 36 for qi deficiency; BL 17 for blood deficiency; LR 3 for hyperactivity of liver yang; SP 10 for blood stasis; and ST 40 for phlegm and dampness. After the arrival of the needling sensation, the needle was manipulated by moderate needling technique. The needles were retained for 30 min and manipulated once every 10 min.
Cui, 2017	Cervical radiculopathy			

6.3. Inclusion Of Cupping Therapy

In both studies involving cupping therapy, wet cupping therapy (WCT) emerged as the favoured approach**.** Hu et al.[65] conducted a comparison between EA applied to Jingjiaji, GB-20, GB-21, LI-15, SJ-5, and SI-3, and WCT combined with moxa patches on GV-14 and Ahsi points, revealing that the latter combination was more effective than EA. Conversely, Meng et al.[66] examined the effects of 10 minutes of wet cupping on GV14 and GB21 on the affected side, juxtaposed with acupuncture at Jingjiaji and GB21 for the same duration. While the VAS scores were comparable between the two groups, laser speckle flowmetry assessments at four intervals up to 15 minutes indicated that wet cupping significantly enhanced blood perfusion in both GV-14 and GB-21 compared to acupuncture. Given the physiological changes observed in the GV14 region of patients with CS, the interplay between dampness and cold, as well as blood stasis and phlegm, suggests that WCT should be considered when such alterations are present.

7. ANALYSIS AND INTERPRETATION

7.1. Evidence from The Current Literature

The central question of this review is whether the integration of Tuina and acupuncture yields superior outcomes for the treatment of CS compared to either modality used in isolation. In the studies that evaluated this combined approach against Tuina or Acupuncture alone, the combination consistently demonstrated enhanced results, achieving this in every case. Furthermore, the groups receiving the combined treatment exhibited the most significant improvements relative to their control groups, which included those treated with acupuncture, medication, or other approaches.

Before proceeding with the analysis, an issue that has to be considered is that most of the efficacy assessment were based on subjective evaluations by the patients (VAS, NDI, etc.), with very few studies measuring objective markers that could potentially elucidate the mechanisms behind the reported improvement. This makes the basis of any investigation and analysis into the potential mechanisms and actions hypothetical for the most part. A further obstacle to an in-depth understanding and analysis is that although TCM uses syndrome differentiation in its diagnostic process, here none was mentioned in all but a few studies, making the results difficult to interpret and thus integrate according to it.

Further, the limited number of studies available, coupled with the diverse nature of the CS types include complicates the establishment of definitive conclusions regarding the optimal modality for specific pathological manifestations. Consequently, a more comprehensive analysis is warranted to elucidate the reasons behind the superior efficacy of this combination, the mechanisms through which it operates, and the specific pathological aspects for which each modality may be best suited. This exploration will be undertaken in the subsequent sections.

7.2. An Investigation into Potential Mechanisms of Tuina And Acupuncture

Numerous pathological mechanisms are implicated in cervical spondylosis, each playing a role in the development of its symptoms. Key contributors include inflammation,

intervertebral disc degeneration, abnormal vascularization, and nerve involvement that can result in neuropathic pain, alterations in the extracellular matrix (ECM), muscle damage, and apoptosis. At the molecular level, both Tuina and acupuncture have demonstrated potential effects on these processes. The subsequent discussion will explore the available evidence from animal studies to assess their impacts.

7.2.1. Effect on Inflammation

Inflammation is a significant factor in the pathophysiology of chronic spinal conditions. The inflammatory milieu that arises within the intervertebral disk (IVD) alters the balance between anabolic and catabolic processes, in favour of catabolism and thereby accelerating disk degeneration. On the other hand, disk degradation and the events associated with it promote a pro-inflammatory environment and create a vicious cycle. Concurrently, the degradation of the disk and its associated phenomena foster a pro-inflammatory environment, establishing a detrimental feedback loop. The transition to a pro-inflammatory state may originate from various factors, one of which includes alterations in the vertebral end plates (EP). These structures are crucial for the nutritional support of the IVD and for sustaining its mechanical integrity; their deterioration can lead to degenerative changes such as instability, disk degeneration, and osteophyte formation. Notably, a key distinction between spondylotic and herniated IVDs is the more pronounced degeneration observed in the inner layer of the annulus fibrosus (AF) and the cartilaginous EPs, which tend to be thicker and more ossified in spondylotic disks. [67] This thickening of the EP further aggravates changes in the adjacent bone marrow, as the migration of nucleus pulposus (NP) material into the neighbouring vertebral body incites inflammation and edema.[68] These bone marrow changes are important predictors of discogenic pain.[69] Inflammatory mediators come not only from the IVD as a product of its degradation but additionally by circulating immune cells which infiltrate inside the disk, due to a number of reasons,[68] which include the muscle injury so commonly present in CS patients.[70]

A variety of pro-inflammatory cytokines are implicated in CS, particularly IL-1β, IL-6, IL-8, and TNF-α. Both acupuncture and Tuina were able to improve the levels of these cytokines, in different layers of tissue. In studies involving rats with intervertebral disc degeneration (IDD), EA was found to decrease levels of TNF-α and IL-1β, the latter being a key contributor to synovial inflammation and cartilage deterioration, specifically within the cervical intervertebral disc (IVD).[71] This intervention effectively delayed collagen breakdown and the fibrotic process by lowering the activity of matrix metalloproteinases MMP-1 and MMP-3, while also restoring the equilibrium between Type I and Type II collagen. [72] Similarly, in models of knee osteoarthritis (KOA), acupuncture led to reductions in TNF-α, IL-2, and the transcription factor NF-κB, which is integral to the pro-inflammatory feedback loop associated with IDD, thereby observably mitigating collagen degradation.[73] The same effect was also achieved in rabbits with KOA-induced injury undergoing Shutiao Jingjin massage,[74] and in KOA rats,[75] with both studies reporting favorable alterations in cartilage morphology. Additionally, a combination of massage and bone-setting was shown to downregulate the TRL4/myD88/NF-κB signaling pathway, which is crucial in the onset of the inflammatory response, as exhibited in another study.[76] The MAPK pathway regulates the inflammatory response, among other functions. EA applied at the cervical Jiaji points was assessed against a combination of cervical Jiaji with ST36 and BL17 (termed Invigorating Qi and Activating Blood – IQAB acupuncture). Both groups exhibited no significant differences in functional assessments (MWT, PWT tests) and demonstrated similar reductions in IL-6 and TNF-α levels; however, the IQAB group achieved a more pronounced decrease in p38-

MAPK and ERK ½ phosphorylation levels.[77] The p38-MAPK and NF-κB pathways are critical in modulating the actions of TNF-α and IL-1β, thus playing a pivotal role in the initiation, maintenance, and amplification of the inflammatory response in CS.[68]
Acupuncture and Tuina have demonstrated efficacy in lowering inflammatory markers irrespective of their anatomical site, serving as effective interventions for inflammatory pain and the broader inflammatory process.[78,79] Additionally, massage therapy has been validated as beneficial for muscle recovery following periods of disuse, overexertion, and physical exercise [80] by modulating the inflammatory response, and in consequence the ECM. Recent studies have confirmed that this effect is applicable not only to adult skeletal muscle but also to aged muscle tissue.[80] Both modalities have therefore shown to be as effective in reducing inflammation in CS.

Table 6 – Acupuncture operating methods

Author, Year	Type of CS	Method Name	Acupuncture points	Operation
Sun, 2014	Radiculopathy	Setting Fire on the Mountain	Jiaji (EX-B 2) points from C4 to C7	The patient took a prone sitting or lying position. Bilateral Jiaji (EX-B 2) points of C7 were punctured using filiform needles of 0.30 mm in diameter and 40 mm in length. Upon arrival of qi, the needle was inserted to the heaven layer first (upper 1/3 of the point depth) during patient's inhalation, followed by 9 times of slow lifting and fast thrusting and rotating to the left at the time of thrusting; then the needle was further inserted to the man layer (middle 1/3 of the point depth), followed by the same procedure; and finally the needle was inserted to the earth layer (lower 1/3 of the needle depth), followed by the same procedure. After this, withdrew the needle directly to the heaven layer to finish one cycle. Repeated three cycles until the warm sensation occurs. Retained the needle for 20 min and pressed the needle hole after removing the needle. Then bilateral Jingjiaji (EX-B 2) points of C4-6 were punctured perpendicularly, followed by even reinforcing-reducing manipulation, 20-minute retaining and pressing of the needle pole after needle removal.
Wu, 2018	Radiculopathy		GV 16, GB 20, Jingjiaji (Ex-B 2) points, GB 21, GV 14, GV 20	After the arrival of needling sensation, even reinforcing-reducing manipulation was performed. Cervical Jiaji (EX-B 2) points were not punctured too deep.
Li, 2024	Radiculopathy	Wrist-ankle acupuncture	The three points of wrists, involving the lateral edge of the radius, Waiguan (the midpoint of the forearm back), and back of the medial margin of the ulna,	The needle handle, holding by the thumb, index finger, and middle finger, with 15°–30° from the needle tip to the skin, was rapidly punctured into subcutaneous skin and then slowly moved into 1.4 inches along a straight line after narrowing the angle to the skin.
Zhao, 2020	Radiculopathy			The positive tender points on the affected side, Luo-Connecting points of the affected meridian and its exteriorly-interiorly related meridian on the unaffected side were chosen to be stimulated for patients in the observation group. If the Bladder Meridian was affected, Tianzhu (BL 10) and Feiyang (BL 58) on the affected side were chosen together with Dazhong (KI 4) from the Kidney Meridian of the healthy side. If the Gallbladder Meridian was affected, Fengchi (GB 20) and Guangming (GB 37) on the

Table 6 – Acupuncture operating methods

				affected side, and Ligou (LR 5) from the Liver Meridian of the healthy side were chosen. If the Triple Energizer Meridian was affected, Tianyou (TE 16) and Waiguan (TE 5) on the affected side, and Neiguan (PC 6) from the Pericardium Meridian of the healthy side were chosen. If the Small Intestine Meridian was affected, Tianchuang (SI 16) and Zhizheng (SI 7) on the affected side, and Tongli (HT 5) from the Heart Meridian of the healthy side were chosen. If the Large Intestine Meridian was affected, Futu (LI 18) and Pianli (LI 6) on the affected side, and Lieque (LU 7) from the Lung Meridian of the healthy side were chosen. If the Stomach Meridian was affected, Renying (ST 9) and Fenglong (ST 40) on the affected side, and Gongsun (SP 4) from the Spleen Meridian of the healthy side were chosen. After routine sterilization, pressed the thumb-tack needle on the acupoint and fixed it with a piece of stick. Took one needle for each acupoint and retained it for 2 d, at a 2-day interval between two treatments.
Song, 2019	Axial neck pain	Zheng's Jin Gou Diao Yu (gold-hook-fishing) acupuncture method	The tender points along the bilateral sides of cervical vertebrae and on the shoulder	Filiform needles of 0.25 mm in diameter and 25-40 mm in length were selected. Inserted the needle with the right hand perpendicularly for 0.5 cun. Then obliquely inserted the needle for 0.5-1.0 cun by a 15-30° angle to wait qi arrival in superficial fascia. Upon qi arrival, applied Jin Gou Diao Yu (gold-hook-fishing) acupuncture method[5], namely twirling the needle body forward for 3-6 times, when feeling heavy and tight, shook the needle tip together with the local tissues for 3-6 times, which looked like a fish swallowing hook. Held the needle to keep the heavy and tight sensation until local muscle was relaxed. Repeated the manipulation for 1 min and retained the needle for 30 min. Finally, withdrew the needle slowly without pressing the hole.
Hu, 2014	Radiculopathy			
Zhao, 2023	Radiculopathy	Gao's nape needling	GB 20, Gongxue, GV 14, GB 21 (on the affected side), Jiao (on the affected side), LI 11, LI 10, SJ5, LI4 (affected side), Wailaogong (EX-UE-8) point (suffered side) and	A deep needling method was used at Jingjiaji acupoints on the neck. A sterile acupuncture needle (specification: 0.25 mm × 50mm) was used for deep straight puncture, so that the needle tip reached the periosteum of the vertebral lamina. Patients with local acid, numbness, swelling, heavy feeling or numbness electricity, to the neck, shoulder, and arm conduction is better; GB 20, Gongxue, and other acupoints were punctured with a sterile acupuncture needle (0.25 mm × 40mm). The method of reinforcing and reducing was used to make the patient get qi, in which GB 20 point and

Table 6 – Acupuncture operating methods

			Ahsi point. C3-C7 Jingjiaji according to imaging examinations	Gongxue point were treated with electroacupuncture, continuous wave, 50 Hz, 30 minutes, once day, 6 days, 1 day off, for 14 days.
Li, 2021	Axial neck pain		Jingjiaji 5–7 (cervical acupoints EX-B2 (C5–C7), Tianzhu (BL10) on both sides, Houxi (SI3) on both sides, Hegu (LI4) on both sides, Geshu (BL17) on both sides and Ashi points.	Weak irritation group: use 0.18 mm × 40 mm acupuncture needles, the patient adopts a sitting position. Tianzhu (BL10), Jingjiaji 5–7 (cervical acupoints EX-B2 C5–C7), Geshu (BL17) straight 0.3 inch; Houxi (SI3), Hegu (LI4), Ashi points 0.5 inch straight. After acupuncture has deqi, the method of flattening, replenishing and reducing is performed, the twist angle is 60°–90°, the frequency is 30–60 times/min, and each acupuncture point is acupuncture for 10 seconds. The needle was retained for 30 minutes, and no needle manipulation was performed during the retention period. After the end, the dry cotton ball presses up the needle. Strong stimulation group: use 0.25 mm × 40 mm acupuncture needles, the patient is in a sitting position. The doctor uses an alcohol cotton ball to disinfect all acupoints first, and then the doctor's hands are disinfected. Tianzhu (BL10), Jingjiaji 5–7 (cervical acupoints EX-B2 C5–C7), Geshu (BL17) straight 0.8 cun; Houxi (SI3), Hegu (LI4), Ashi points straight 1 cun. After the acupuncture has "arrival of Qi", the method of flattening, replenishing and reducing is performed, the twisting angle is 90°–180°, the frequency is 60–90 times/min, and each acupoint is acupuncture for 1 minute. The needle was retained for 30 minutes, and the above-mentioned method of replenishing, replenishing and reducing was performed once every 10 minutes. After the end, the dry cotton ball presses up the needle.
Gu, 2019	Axial neck pain	Seven acupoint-penetrating needles		PC6 through PC7 (the same meridian penetration), GV20 through GV21 (the same meridian penetration), ézhōng through Yìntáng, GV17 through GV16 (the same meridian penetration) on the left side; GV16 through GB20 (different meridian penetrations), GB12 through SJ17 (different meridian penetrations) on both sides; SP6 through GB39
Zhu, 2017	Vertebral artery type		C3-C7 Jiaji, BL17, BL18	Needles 0.25 mm in diameter and 25-40 mm in length were punctured by 30 ° lateral to the spine with a depth of 13 mm at C3-C7 Jiaji (EX-B 2) points on bilateral sides, and reducing manipulation of twirling and rotating were performed after qi arrival; obliquely punctured towards spine for 13-20 mm at Ganshu (BL 18) and Geshu (BL 17) and did even reinforcing-reducing manipulation after qi arrival. Manipulation every 10 minutes.

Table 6 – Acupuncture operating methods

Yang, 2023	Radiculopathy	Qi Huang needle therapy	The first set of acupoints was C6 Jiaji point, LI15; the second set was C4 Jiaji point, LI14; and the third set was the extra point-Jian qian, TE4 (affected side).	The patient was placed in a prone position with a soft pillow on the chest and the hands were folded in front of the forehead to fully expose the skin of the neck and neck. The operator disinfected both the hands and the skin of the treatment site, the left thumb was positioned on the point, the index and the middle fingers were placed on both sides of the point, the Qihuang needle was held, and the needle was flown (inserted) into the skin quickly. After insertion, the thumb and forefinger were used to push the needle body slowly. The depth of the needle was ∼25–35 mm according to the patient's body weight. First, the infusion method, with the needle tip straight to the bone surface, was used, and the needle handle was gently shaken in small increments for ∼5 s. Then, the needle handle was gently swung at an angle of 15◦ along the longitudinal axis of the body to perform Hegu thorn needling. The needle was then fed forward and backward or left and right at an angle of 15◦ to 20◦ from the original direction, with a light and small swing of the needle handle for ∼10 s. The operation time of each point was ∼15 s. After the local soreness and swelling became prominent, the needle was quickly removed, and the sterile dry cotton ball was pressed for a few moments.
Lin, 2014	Axial neck pain		PC6	The needle was perpendicularly placed into the skin (0.5-0.8cm),asking the patient to move neck during the process and the operator adjusted the position; when got a smooth feeling under the needle, then left the needle in the position for 20 minutes. Haemospasia: Selected both middle fingers. First of all, found the tiny blood vessels on the fingerprint, then routinely disinfected, the tiny blood vessel was rapidly pricked with a 6 gauge disposable needle and extruded 1-2ml blood.

Table 7 – Supplementary methods to acupuncture

Author, Year	Type of CS	Supplementary method	Operations
Sun, 2014	Radiculopathy	-	-
Wu, 2018	Radiculopathy	Herbal Patches	Preparation of externally applied medicine: Jilma Oak (translated according to the pronunciation, it belongs to Uyghur medicine), Wei Ling Xian (Radix Clematidis), Ge Gen (Radix Puerariae), Tou Gu Cao (Herba Speranskiae Tuberculatae) and Hong Hua (Flos Carthami) were milled into powder. The five herbs were at a ratio of 4:2:2:1:1 and immersed in 75% alcohol with the liquid level appropriately above them for 24 h before use. five grams of the above mentioned medicine made into 1 cm × 1 cm herb cakes were applied to each acupoint. The herb cakes were attached to each acupoint by a tape for 12 h every day for continuous 10 d.
Li, 2024	Radiculopathy	Moxibustion/ Hot compress	Moxibustion (moxa cones) was applied to the acupoints, including the Jingbailao point, Dazhui point, Jianzhongshu point, and Zhongzhu point. Moxibustion lasted 30 minutes through rotating the moxa cones to prevent burn. The treatment was conducted once on alternate days and 5 days for a course. Hot compression with Chinese herbal medicine, which is good for improving blood circulation and dispersing stasis, was performed on the patients' neck.)e Chinese herbal medicine used for hot compression included monkshood, spatholobus stem, Paeonia lactiflora, and Caulis Sinomenii, with 30 g each, all of which were put together in a cloth bag after steaming to about 70°C in a steamer. The bag was quickly moved back and forth on the patient's neck and shoulder until bag's temperature dropped to about 50°C and then was applied to the neck and shoulder until heat disappeared. The treatment was maintained 15–30 minutes once, twice a day with 15 days as a cycle. During the treatment, the patients in the two groups got enough sleep and neck-shoulder-back muscle exercises.)e efficacy was evaluated after 30 days.
Zhao, 2020	Radiculopathy	-	-
Song, 2019	Axial neck pain	-	-
Hu, 2014	Radiculopathy	Herbal medicine	Modified Shentong Zhuyu decoction: Semen Persicae 20g, Flos Carthami 20g, Radix Angelicae Sinensis 20g, Rhizoma Chuanxiong 20g, Rhizoma Et Radix Notopterygii 15g, Radix Gentianae Macrophyllae 15g, Oletum Trogopterori 15g, Myrrha 15g, and XiangRadix Aconiti Lateralis Preparata 15g, Radix Achyranthis Bidentatae 10g, Pheretima 10g, and Radix Glycyrrhizae Preparata 10g. One dose of 300mL per day is taken warm in the morning and evening. The treatment is continuously taken for 14 days.
Zhao, 2023	Radiculopathy		

Table 7 – Supplementary methods to acupuncture

Li, 2021	Axial neck pain	-	-
Gu, 2019	Axial neck pain	-	-
Zhu, 2017	Vertebral artery type	-	-
Yang, 2023	Radiculopathy	-	-
Lin, 2014	Axial neck pain	-	-

7.2.2. Effect on Disk Degeneration

Disk degeneration can come either a result of or be the cause of vertebral EP thickening and calcification, which will progressively weaken the supply of nutrients to the IVD due to the EPs acting as a selective permeable barrier tightening on calcification and blocking the blood supply to the disk.

The deterioration of the intervertebral disk initiates within the NP. Chondrocytes are responsible for the synthesis and degradation of proteoglycans that constitute the ECM of the NP, which is essential for retaining water and collagen, thereby sustaining the hydrostatic pressure required for the uniform distribution of mechanical loads to the AF and the EP. Factors such as injury, imbalances in loading, or degenerative alterations that hinder the transport of metabolites can disrupt the NP ECM. This disruption leads to an imbalance in the synthesis of critical matrix components by intervertebral disk (IVD) cells, including aggrecans, which are vital for maintaining disk height, and type II collagen. Concurrently, there is an upregulation of degradative enzymes, particularly matrix metalloproteinases (MMPs), which promote cellular apoptosis. Ultimately, these matrix components are replaced by fibroblast-like cells in a process of gradual fibrosis,[5] which is further characterized by the production of Type I/ Type II collagen increasing for Type I, a process expedited tremendously by inflammation as well.

The most prevalent MMPs implicated in IVD degradation include MMP-1, MMP-2, MMP-3, MMP-9, MMP-13, and ADAMTS-5. Research involving rats with IDD has shown that acupuncture can restore the balance of Type I and II collagen while decreasing levels of MMP-1 and MMP-3.[72] A systematic review and meta-analysis conducted in 2023 indicated that acupuncture consistently lowered MMP-1, MMP-13, and ADAMTS-5 levels in animal models of KOA, while simultaneously restoring the ECM components, specifically Type II collagen and aggrecan.[81] his review further concluded that acupuncture mitigated chondrocyte apoptosis and enhanced the morphometric characteristics of cartilage, effectively inhibiting pro-apoptotic pathways. Additionally, EA was found to improve cartilage structure, reduce cellular degeneration, and lower MMP-3 and inflammatory markers in KOA rabbits.[82]

Research on the effects of Tuina or massage in reducing matrix metalloproteinases (MMPs) is limited, with only one notable study indicating that the combination of EA and Tuina led to a reduction in MMP-1 activity and an increase in the activity of tissue inhibitors of metalloproteinases (TIMPs) in rat skeletal muscle.[83] In a model of knee osteoarthritis (KOA) in rats, Tuina was found to decrease the number of apoptotic chondrocytes, improve the organization of synovial cells, reduce the infiltration of inflammatory cells, and mitigate the hyperplasia of fibrous tissue.[75] In the sole study of Tuina in aging rats (over 12 months), the kneading of the Shenshu BL23 point was associated with the preservation of cell life, as well as improvements in the distribution and morphology of the IVD. Additionally, this study reported a downregulation of oxidative stress markers, such as reactive oxygen species (ROS) and malondialdehyde (MDA), alongside an upregulation of antioxidant defenses, including superoxide dismutase (SOD) and glutathione (GSH).[84] The same study found that NP cell senescence was delayed though the regulation of SIRT1/FOX01 pathway which inhibits osteoarthritic gene expression.[85] Similarly, Shutiao Jingjin massage applied to KOA rabbits resulted in improvements in cartilage morphology, inflammation, and apoptotic markers, including Bcl-2, Bax, and caspase-3.[74] In a separate study involving rats with dorsal root ganglion (DRG) compression, while mechanical reflex responses improved, there was no observed effect on cell necrosis.[86] Therefore Tuina has demonstrated its potential to enhance morphological characteristics, likely through the promotion of cellular survival.

7.2.3. Effect on Osteophyte Formation

In a study involving 4,271 cases of CS in northern China, it was observed that 80% exhibited osteophyte formation, although a significant number remained asymptomatic.[87] Research has identified several advantages associated with Tuina and acupuncture, particularly in relation to osteophyte formation, as evidenced by two animal studies. Transforming growth factor-beta 1 (TGF-β1) is recognized as a significant factor that triggers chondrogenesis.[88] In a study mentioned previously, together with the other effects, EA with Tuina in rat skeletal muscle, managed to downregulate TGF-β1 levels.[83] Furthermore, Tuina applied along the Bladder meridian demonstrated a downregulation of the TGF-β1/Smad pathway, which is known to initiate fibrotic responses, in a rabbit model with punctured IVD and AF.[89] Acupuncture alone has also been shown to influence the fibrotic process similarly. In a model of KOA in rats, EA resulted in decreased levels of TGF-β1.[90] This effect has been observed in other conditions as well; for instance, in cases of renal interstitial fibrosis, acupuncture downregulated TGF-β1/Smad3, and inflammatory markers.[91] Similar outcomes were noted in a model of heart failure that induced myocardial fibrosis, specifically concerning the TGF-β1/Smad pathway.[92]

7.2.4. Effect on Pain Mechanisms and Central Sensitization

The alterations observed in CS, as previously mentioned, may lead to an extended nociceptive input that modifies the perception and processing of pain via alterations in neuroplasticity, blood flow, and the central nervous system's (CNS) handling of nociceptive signals. This phenomenon, known as central sensitization, is a defining feature of chronic musculoskeletal pain and is evident in a significant number of patients. [93, 94] While the traits of central sensitization can manifest independently of such nociceptive input, an in-depth exploration of these distinctions falls outside the scope of this review. Therefore, for the purposes of this discussion, we will focus on the mechanisms associated with the sustained presence of nociceptive input.

Muscle strain resulting from intervertebral disc degeneration (IDD) or disuse injuries can lead to ischemia, subsequently affecting the pH of the surrounding tissues and triggering an inflammatory response.[95] Ischemic conditions sensitize muscle nociceptors to mechanical stimuli, which increases the density of nerve endings within the muscle tissue that are associated with pain mediated by neuropeptide secretion,[96] mainly Substance P, Calcitonin gene-related peptide (CGRP), and Somatostatin. The analgesic effects of acupuncture are thought to be linked to the downregulation of Substance P,[97] while several human studies have indicated that both acupuncture and Tuina may also reduce levels of CGRP and Endothelin-1. Additionally, Prostaglandin E2 (PG-E2), a molecule that enhances the excitatory potential of nerve endings in muscles, has been shown to be downregulated in rat cervical intervertebral discs following acupuncture treatment.[72]

At the distal end of the nerve fibers, the degenerating intervertebral disc exhibits not only an overproduction of Substance-P but also an abnormal expression of neurotrophic and neurotropic factors from the neurotrophin family.[68] This phenomenon highlights the enhancement of the spinal input region associated with chronic pain conditions.[94] NMDA receptors play a crucial role in the development of this input region within the spinal cord.[98] Research indicates that Tuina therapy leads to a downregulation of the NMDA receptor subunit NR2B and the post-synaptic density protein (PSD-95) in the dorsal horns of rat spinal cords. Additionally, this study observed a reduction in the number of dendritic branches and a decrease in the overall length of neurons.[99] In contrast, EA applied to CSR model rats

resulted in significant improvements across all previously mentioned mechanisms, including enhanced levels of Substance-P, PG-E2, a-synapsin, synapsin 1, synapsin 2, PSD-95, and GAP-43.[100] Furthermore, acupuncture treatment downregulated vascular endothelial growth factor (VEGF), [72] which facilitates the increased vascularization which accompanies nerve growth during central sensitization.[68]

Alterations in brain functional connectivity have been observed in patients experiencing central sensitization.[101] Such changes also occur in patients with cervical spondylosis,[102] and involved changes in connectivity of the DMN and sensory-motor areas. Research indicates that acupuncture can influence brain connectivity within these specific areas.[103]

While the presence of central sensitization in patients with CS has not been conclusively demonstrated, it is reasonable to hypothesize that some of these mechanisms are implicated in individuals with chronic and persistent symptoms. Preliminary evidence suggests that both acupuncture and Tuina may positively impact these mechanisms in the contexts of treatment and prevention.

7.3. Assessment of Tuina Methods

7.3.1. Impact on Atlantoaxial Instability – CS Vertebral Artery Type

Concerning atlantoaxial instability, two studies were conducted that focused on manipulative techniques aimed at restoring the alignment of the atlantoaxial joint. Some of these methods may also be relevant for addressing dislocations at other spinal levels. Wei et al.[59] used thrust manipulations prior to the adjustment of the atlantoaxial joint, aimed at adjusting the entire cervical spine, which is a technique not utilized in the other studies. The application of thrust manipulations offers numerous potential advantages, including the facilitation of relaxation in the paraspinal muscles and an enhancement in the separation of the joints and vertebrae.[104] This method followed by Wei had the lowest TER (78.1%). Among the studies that involved joint manipulations, the research conducted by Ma et al.[52] featured a more comprehensive approach, incorporating a wider range of techniques as it utilized three distinct methods. Zhao's [43] study employed a technique that was more akin to traction.

The literature examined clearly includes methodologies that address various potential patho mechanisms associated with CS VAT. Spinal manipulative therapy targeting the atlantoaxial joint may prove beneficial in enhancing rotational range of motion (ROM), particularly in instances of mild CS, where the processes leading to stiffness have not yet advanced. This intervention could serve as a preventive strategy against further deterioration while alleviating compression of the vertebral artery. Conversely, in cases of advanced degeneration, the presence of osteophytes in CS patients is closely linked to the occurrence of vertigo, predominantly at the uncovertebral joints located at the C5-C6 spinal levels, which themselves indicate significant degenerative changes.[105]A 2012 study by Ding[106] in CS VAT patients revealed that spinal manipulation improved symptoms and the vertebral artery blood flow. Similarly, Fan's study [42] corroborated these findings; however, it was noted that neither study demonstrated a reduction in symptoms associated with osteophyte presence, as there were no significant differences in vertebral artery blood flow between the observation and study groups. In contrast, Fan's methodology primarily concentrated on segmental instability and did not specify the presence of osteophytes in its inclusion criteria. Nonetheless, spinal manipulation has the potential to alleviate symptoms, thereby playing a crucial role in enhancing load distribution by realigning the facet joints and mitigating the overstimulation of the cervical sympathetic plexus, although these proposed mechanisms require further validation.[104] Additionally, a study on high-velocity low-amplitude (HVLA) manipulations indicated their potential to enhance cervical muscle strength, making them relevant for neck-

type cervical spondylosis.[107] On the other hand, Xu[53] implemented the Kai Qing Long Suo method, in combination with warm needling, to alleviate muscle spasms in the trapezius which are consistently present in patients suffering from CS, and provided a framework for working with both modalities in CS VAT.

It is plausible to suggest that when osteophytes exert pressure on the vertebral artery, the efficacy of manipulation in altering this condition may be limited. Techniques such as traction, which aim to increase the intervertebral space, could be perceived as more appropriate for addressing this issue. However, a study that compared manual therapy aimed at expanding the intervertebral space with a control group found no significant differences in outcomes. [108] Another study[109] comparing three different manual therapy methods, found that mobilization achieved better pain relief than high-velocity low-amplitude (HVLA) manipulations, in healthy patients. In a younger sample of cervical spondylosis patients aged 19 to 47, a comparison of sustained versus intermittent cervical traction indicated that sustained traction was more effective in enhancing the range of motion (ROM) in flexion and extension. Notably, the improvements observed in both traction methods were not maintained, as evidenced by measurements taken five minutes post-intervention.[110] This aligns with the conclusions of a review on manual therapy for cervical spondylosis,[110] which indicated that both traction and mobilization can yield short-term pain relief and improvements in ROM. These findings reinforce the idea that manipulations and traction should be considered integral components of the treatment regimen for various forms of cervical spondylosis. Evidence supporting the effectiveness of methods such as traction, high-velocity low-amplitude (HVLA) manipulations, and passive movement as standalone treatments is moderate. [11] However, a number of reviews agree that each of these methods, can be enhanced when used in conjunction with other methods in a multimodal approach.[111, 110]

7.3.2. Impact of Tuina On CSR And Disk Herniation

The bulk of the studies addressing CSR focused mostly on treatment by acupuncture. Nonetheless, there exists one study that exclusively examined Tuina, alongside three studies that investigated a combination of both acupuncture and Tuina. Determining the reasons for the varying effectiveness of these treatments remains challenging. Typically, CSR tends to resolve within a timeframe of two to three years[112] and research into various treatment approaches have not yielded sufficiently conclusive results to guide clinical decisions. In instances of severe pain where immediate relief is necessary, surgical intervention has demonstrated short-term efficacy when compared to alternative treatments; however, long-term evaluations have not indicated any significant advantages over other therapeutic options.[113]

Wang et al.[50] conducted the most effective study within this review, demonstrating that the combination of auricular acupuncture (AA) and Tuina achieved a remarkable 100% treatment efficacy rate (TER). The analgesic properties of AA are attributed to its ability to activate the descending pain inhibitory pathways in the brainstem, which subsequently suppresses the ascending pain pathways through mechanisms involving the release of β-endorphins. [114] Notably, the average age of participants in this study was only 39.4 years, raising concerns about the generalizability of these findings to individuals with more advanced stages of disc degeneration and greater spondylotic changes.

Disk herniation accounts only for 21.9% of CSR cases,[40] however it is a common phenomenon in CS. Interestingly, in that case, Wen[44] focused treatment only on tender points on the affected groups of muscle, using quite strong pressing manipulation and deep

stimulation. This approach specifically highlights the treatment of the compensatory muscular distortions that often accompany instances of disk herniation.

7.4. Summary and Conclusions

7.4.1. The Complementary Use of Acupuncture And Tuina

Research consistently indicates that the integration of acupuncture and Tuina yields superior outcomes compared to the application of either modality in isolation. From the perspective of TCM, acupuncture and Tuina target different layers of the disease process; Tuina primarily affects the muscle channels, bones, and collaterals, while acupuncture influences the primary channels in a more generalized manner. However, this assertion lacks corroborative evidence from a Western Medicine (WM) viewpoint. Previous animal studies have shown that both acupuncture and Tuina positively affect the inflammatory response, intervertebral disc regeneration, vertebral artery circulation, pain symptoms, and symptoms associated with CS, with no significant molecular differences observed between the two treatments. In contrast, when viewed macroscopically, Tuina appears to have a more pronounced effect on the structural aspects of the condition than acupuncture. Notably, no studies have demonstrated improvements in cervical curvature when acupuncture was employed as a standalone treatment, unlike the findings associated with Tuina. Furthermore, it is evident that acupuncture, by its nature, cannot rectify vertebral positioning in cases of segmental instability, although it has been effective in addressing muscular distortions and lesions. This illustrates the complementary nature of these two therapeutic approaches. While molecularly the two modalities may exhibit minimal differences, their practical applications reveal distinct strengths, suggesting that their combined use may enhance therapeutic outcomes.

Patients presenting with CS in clinical settings often exhibit significant variability in terms of age, lifestyle, symptomatology, and pain levels. This heterogeneity underscores the potential benefits of integrating acupuncture and Tuina therapies, which can enhance treatment efficacy and address the complexities of individual cases more profoundly. Elderly patients frequently experience concurrent conditions such as frozen shoulder, which may result in a markedly low pain threshold, thereby complicating the application of local Tuina or acupuncture techniques. In such scenarios, employing distal acupuncture points, such as those located on the wrist and ankle, may offer a more effective therapeutic approach. Additionally, some patients may present with structural issues in the cervical region that contribute to their symptoms, while also experiencing the effects of internal organ patterns such as Liver Qi stagnation, which can manifest as upper back and shoulder stiffness, alongside emotional symptoms like anger and irritability—conditions that are commonly observed in CS patients.[115] In that case, the use of both modalities would certainly be able to assist the patient in a more complete manner.

In conclusion, while research involving animals suggests that acupuncture and Tuina exhibit comparable effects and activate similar physiological mechanisms, the evidence indicates that their combined application yields superior outcomes. However, the underlying reasons for this enhanced efficacy remain unclear and warrant further investigation. Practically speaking, Tuina is particularly effective in addressing structural abnormalities, including range of motion limitations, segmental instability, muscle injuries, and focal adhesions, as well as alleviating nerve compression. Conversely, acupuncture is beneficial for modulating pain perception by stimulating the primary meridians, as discussed in the context of CSR, and for addressing individual constitution and associated patterns.

Therefore, the integration of both techniques can provide significant benefits for both patients and practitioners, playing a vital role in establishing a successful and effective treatment regime.

7.4.2. Observations from Tuina Literature

Tuina has been effectively employed in the treatment of various types and stages of CS. This suggests that Tuina is a versatile therapeutic approach, encompassing a range of techniques that include traditional massage as well as chiropractic and osteopathic methods. Although a thorough investigation into the underlying mechanisms of these techniques yielded inconclusive results, the observed improvements in patient outcomes are irrefutable.

A recurring observation in the literature is the substantial time allocated to the relaxation of muscles and tissues in the neck, back, and shoulder areas prior to any manipulative adjustments. This preparatory stage is essential not only for reducing muscle tension but also as a necessary condition for successful adjustments, given that stiff muscles can hinder the manipulation process. Another prevalent trend noted is that the application of high-velocity low-amplitude (HVLA) manipulations ceases once symptoms have subsided or ROM has been restored. Despite the prevailing belief that HVLA manipulations pose risks and dangers, research indicates that they can generally be deemed safe. While transient side effects are frequently observed in HVLA procedures, these typically resolve within a 24-hour period. Although vertebrobasilar insufficiency is recognized as a contraindication for HVLA, it consists an indication in Tuina. Evidence suggests that numerous adverse events in the cervical spine may stem from passive movement and examination techniques conducted prior to manipulation. Although a review identified low to moderate quality evidence regarding Chinese bone setting, it did not yield definitive conclusions that would preclude their application. Nonetheless, certain factors, such as smoking, the presence of comorbidities, and female gender, have been identified as increasing the likelihood of adverse events.[116, 117, 118] It is essential to take age into account prior to administering high-velocity low-amplitude (HVLA) manipulations, as degenerative changes in the cervical spine tend to peak between the ages of 50 and 59.[119] Given that some of these changes, such as herniated discs and osteophytes, may be asymptomatic, a prudent approach is advisable in the absence of imaging studies.

Additionally, passive movement plays a significant role in treatment, particularly in addressing forward head posture and cervical lordosis.[120] As noted, research indicates that a multimodal treatment strategy is essential, necessitating careful deliberation by the practitioner to determine the most effective sequence of interventions tailored to each individual patient.

8. THE TREATMENT OF CS: TOWARDS A PRACTICAL APPROACH

8.1. Introduction

In WM, the comprehension of CS is primarily localized to the cervical region. In contrast, TCM presents a more intricate understanding of pathogenesis, which inherently influences treatment approaches. The manifestation of CS is associated with three principal factors: the condition of the internal organs, which is represented by the Zang-Fu theory; the condition of the tissues, which pertains to the health of the associated structures such as the muscles,

tendons, and bones; and the status of pathogenic factors, which may arise through the interaction of the interior with exterior and include wind, cold, and dampness.. Consequently, an effective treatment strategy must encompass all these components, and the interplay among them will be explored in subsequent chapters, beginning with the common constitutions of CS patients and their implications for treatment.

8.2. Points of Attention

8.2.1. Constitution In CS

In light of the various interpretations and inquiries surrounding the term "constitution," it is essential to elucidate its meaning within this context. Here, "constitution" refers to the primary attributes of an individual's health status, which encompasses the overall equilibrium among Qi, Blood, Body fluids, Yin, and Yang. Our focus is not on the inherited constitution but rather on the current condition of the patient's physical and mental state at the time of their presentation. Consequently, it is possible for an individual to exhibit multiple types of constitution, i.e. Qi deficiency coupled with phlegm-damp. Indeed, the presence of more than one type of constitution is frequently observed in clinical settings.

Ding et al.[115] conducted a systematic review focusing on constitution in CS, revealing noteworthy insights from the analysed literature. A significant finding was that a majority of patients with CS (72.5%) exhibited what is referred to as comprehensive constitution, indicating the presence of both a primary and a secondary constitution, as illustrated in previous examples. Another critical observation was that the reviewed studies predominantly identified Yang deficiency constitution, along with its associated types such as Qi deficiency, Qi stasis, Blood stasis, Phlegm-Damp, and Qi/Blood deficiency, as the most common among CS patients. Additionally, it was noted that Yang deficiency constitution was particularly prevalent among perimenopausal women.

The implications of these findings warrant careful consideration. A general deficiency in Yang serves as a conducive environment for the onset of Bi syndrome, primarily due to the compromised overall resistance at the tissue level and the resultant formation of cold and damp conditions internally. In such scenarios, external invasions may occur without directly involving the Lung channel, but affecting the Taiyang channel, which runs through the cervical region.

Yang deficiency might be something that can be expected in people of a certain age. But a deficiency of Yang in its protective aspect can also affect people who work in the same position for hours, which results in poor circulation in the more superficial aspects of the channels. Professor Liu Deming underlines that individuals working in air-conditioned environments, especially in occupations that strain the neck, are particularly susceptible to cold-damp infiltrating the Yang meridians of the neck, leading to obstruction.[121] In that case, he advocates for a treatment approach aimed at warming the meridians and dispersing cold.

Yang deficiency primarily impacts the Spleen and Kidney, which are considered the key organs involved. The HDNJSW articulates that a weakening of Yang Qi leads to a phenomenon described as "cold recession," closely linked to the depletion of essence and the consumption of qi and blood. This illustrates how the absence of Yang Qi can result in the formation of cold. The roles of the Spleen and Kidney indicate that the depletion of essence is not the sole factor; the Spleen's capacity to generate Qi and Blood is also crucial, and both may fail to adequately support the body's exterior defences, and facilitate the invasion of Wind.

The assessment of a patient's relative state of excess and deficiency can dictate the choice of acupuncture points, the force of Tuina manipulations, and the depth and degree of

stimulation. For instance, a patient with a chronic deficiency is unlikely to withstand vigorous techniques like point-pressing, similar to a patient who demonstrates long standing stagnation. Therefore, careful consideration is necessary.

8.2.2. Qi Deficiency and Dampness

Qi deficiency should be examined first at the local level. The Huangdi Neijing Zhu Ping commenting on chap. 3 of the HDNJLS says: “The 365 needle insertion holes in the intervals of the joints are distributed over the entire body. They are the locations where the qi and the blood from the network vessels pour into the entire body’s joints.” Therefore, when there is a blockage caused by accumulation the nourishment provided by qi and blood will not reach the tissues. Research examining the relationship between Qi deficiency syndrome and interstitial fluid and blood circulation has demonstrated that Qi deficiency correlates with an increase in interstitial fluid volume and/or disruptions in nutrient distribution, as well as the retention of metabolic waste.[122] This supports the traditional Chinese medicine (TCM) perspective that Qi deficiency results in reduced energy supply and the accumulation of dampness.

It is important to facilitate the movement of Qi within the meridians of the neck, shoulder, and arm regions. Supporting the notion that Qi deficiency and dampness go hand in hand locally,, a recent retrospective study indicated that patients with CS often exhibit thickening of the fascia around the GV-14 area, with a positive correlation to the severity of CS, particularly in cases of CS myelopathy.[123] Therefore, Tuina techniques that target the larger surrounding areas and promote heat penetration seem to be warranted in addressing these issues.

Another important aspect of Qi and yang deficiency comes from Wang Bing’s comment on HDNJSW chap.12 that says “rubbing the sinews and joints facilitates the flow of Yang Qi.” This suggests the importance of employing passive movements and Tuina techniques in the cervical region, but also in all the areas covered by certain meridians. Given that CSR impacts extensive lengths of the arm's Yang channels, it is essential to mobilize and warm the points surrounding the joints, including the elbow, wrist, and shoulders. In cases of more severe and systemic Qi and Blood deficiency, access to the primary channels becomes imperative, something that can be facilitated by acupuncture. The HDNJLS chap. 47 indicates that "the conduit vessels... nourish the sinews and bones, rendering the joints flexible." However, this nourishment occurs through the collaterals or network vessels, as stated previously. Consequently, prior to harnessing Qi and Blood from the primary channels, it is necessary to eliminate blockages within the collaterals, which helps to define the roles of Tuina and acupuncture in treatment.

8.2.3. The Liver In CS

A significant consequence of Yang/Qi deficiency that plays a crucial role in CS is its impact on the Liver. While the liver pathology associated with CS primarily pertains to its Yin aspect, particularly in relation to deficiencies in the Liver and Kidney, it is important to note that an earlier stage may involve a deficiency of Liver Blood. This deficiency may arise from the Spleen's inability to produce adequate blood, leading to malnourishment of the joints, or a decline in Kidney essence. Furthermore, the repercussions of Yang deficiency extend to the liver's capacity to regulate Qi flow, which subsequently affects both the physical and mental/emotional states.[124] These interconnections are evidenced by a study utilizing a meridian detector,[115] which revealed an empty liver meridian, indicative of deficiencies in

both liver Qi and liver blood, while the bladder meridian appeared full, suggesting the presence of a pathogenic factor or a stagnation of Qi and blood. Another investigation into the emotional states of patients with CS identified anger as the predominant emotion in both males and females.[115] Notably, male patients exhibited anger and joy as the most common emotions, whereas female patients displayed anger and worry. This distinction reflects the predominance of Qi in males, where liver Qi stagnation transforms into fire, impacting the heart, while in females, the emotional responses are influenced by blood deficiency, highlighting the women's relationship with it. The Liver may also affect the joints through its Blood/Yin aspect, particularly in the presence of Kidney Yin deficiency. In 252 CS patients a deficiency of Liver and Kidney Yin was the predominant pattern in 11.9% of cases, ranking third overall.[18] The HDNJSW chap. 59 explicitly states that "the joints of the bones are the places where the hollow space in the bones is filled…….When a disease is in the joints the cure must be directed at the hollow space in the bones. The marrow fills the bones. Hence [diseases in the] bones are cured by augmenting the bone marrow."

Setting the systemic deficiency aspect aside there is another way that the Liver can be involved, and this has to do with the ability of the liver to govern the sinews. In the study by Gu,[61] points of the foot and hand shaoyang meridians were used, along with points of the Du Mai together with SP-6 for CS patients which was more effective than needling head points combined with traction. No specific CS type was mentioned and no imaging was provided so we cannot be sure of any degenerative changes, however the average age was 45 +/-3.14 years. Another study[62] found that needling PC6 and bleeding the baxie point on the middle finger was equally effective as conventional points. A further study[64] illustrating that point added BL17 and BL18 which enhanced the efficiency of local points in people of a younger age. Zhu, 34.1 +/- 3.5 years old.

Given that CS has been found to be prominent in IT workers but also in people who spent a lot of time on their phone points to the consumption of Liver-blood by excessive use of the eyes, and by blockage of the tendons by prolonged working postures. Again, in cases where systemic deficiency is not predominant, attention should turn to that aspect.

8.2.4. Shen

All pain relates to the heart, according to the HDNJSW chap. 74 Therefore, this aspect of should be calculated in the treatment decision. Besides the heart, the brain is the other anatomical organ functionally related to the Shen. This may provide an explanation as to why patients with cervical radiculopathy responded so well to auricular acupuncture, a hypothesis further justified by the fact that the average age of the participants was 39,4 years old, which is too early for severe degenerative changes such as osteophytes to take place. Since auricular acupuncture works directly on the descending and ascending pain pathways, suggests that combining auricular acupuncture with Tuina might be more effective than focusing on the local or distal points, at least for cases of mild cervical spondylosis where degenerative changes are not very advanced.

Another fact related to the Shen that should be considered in treatment is the prevalence of anxiety and/or depression in patients with neck pain, but also with chronic pain in general.[125,126, 127] Since the co-existence is common, they should be calculated in the treatment strategy.

8.3. Acupuncture Point Selection

The HDNJLS chap. 52 articulates that "the six-fu transmit and modify material items. Their Qi internally seeks to reach the five-zang; externally, they connect the limbs and joints." This assertion underscores the necessity of directing treatment towards the Yang meridians. Given that these meridians are responsible for supplying the tendons, bones, and joints, a deficiency in Qi or Yang, accompanied by the accumulation of cold and subsequent stasis of Qi and Blood, necessitates the stimulation and warming of the meridians. This can be achieved through techniques such as moxibustion, warm-needling, or other warming modalities, alongside Tuina manipulations aimed at clearing the collaterals and enhancing Qi circulation within the joints, as cold tends to settle in the joints.[128] In instances of Blood or Yin deficiency, it is equally important to restore the flow of Qi within the Yang meridians. The HDNJSW chap. 16 identifies the foot shaoyang, hand yangming, and hand taiyang as contributing factors to stiffness in the lower back and nape, which may arise from a recession and counter-movement of Qi. As the Nanjing states, "the Shu/Stream points are indicated for pain in the joints and are associated with dampness." The HDNJSW chap.74 notes that "all cases of tetany and stiff nape without exception are associated with dampness." Utilizing the Shu/Stream points of the Yang channels, particularly LI-3 (due to it being on the Yangming meridian) and SI-3 (due to its relationship with the Governor vessel), may yield therapeutic benefits. SI-3 was one of the most frequently used distal points. [129]

The selection of channels for treatment necessitates an understanding of their relationship with the fundamental pattern. Given the prevalence of Yang deficiency in cases of CS, it is essential to explore the role of the Governor vessel, which serves as the convergence point for all Yang channels. Regarding the influence of external cold, the Nanjing text indicates that "the Qi of Wind-Cold enters the brain through the Wind palace," thereby suggesting the application of GV-16 in instances where cold manifests with symptoms such as occipital pain, dizziness, and headaches. According to Xie,[124] external pathogenic factors can affect all cervical meridians, compromising the essence of the brain marrow. Consequently, in addition to DU-16, treatment should also focus on both BL-10 and GB-20.

In the context of CS VAT, a research into several acupoints associated with the Gallbladder (GB) and Bladder (BL) meridians found some of them to have the ability to promote blood flow through the vertebral artery. Specifically, the relevant points for the Bladder meridian include BL-10, BL-40, and BL-64, while the Gallbladder meridian points are GB-20 and GB-34.[130]

The application of BL-11 may also be relevant when addressing a Ying-Wei imbalance, which is fundamental to the development of CSR.[131] In this context, BL-11 warrants attention as it serves as a point associated with the Sea of Blood, thereby reinforcing the exterior and acting as a convergence point for the bones. This characteristic renders it suitable for treating both marrow deficiency and blood/yin deficiency. Blood and Marrow are mutually supplementing, which prompts its use in the case of a blood deficiency, either due to the deficiency of the Liver blood not nourishing the tendons, or to a general blood insufficiency.

There exists a discussion regarding whether BL-11 or GV-14 serves as the primary meeting point for the bones.[132] While it is not within the current scope to ascertain this, the application of GV-14 has been noted in various cases to enhance blood circulation to the head, utilizing methods such as tapping, cupping, bleeding, or warm-needling. This may influence the selection of either point based on the degree of Yang deficiency and the intended therapeutic outcome. GV-14 appears to be particularly beneficial for the cervical vertebrae, since the Du Mai is the channel of the spine, where it can be effectively paired with GV-20 or GV-16. Conversely, if the objective is to bolster Yang in the exterior, particularly in the upper back

and shoulder regions, BL-11 should be taken into account not only for the aforementioned reasons but also due to its association with the Hand Taiyang Small Intestine meridian. This is particularly relevant as numerous muscular issues in the Hand Taiyang region of the upper back are observed in patients with CS.[133]

From another angle, considering that the six fu organs transmit and modify material substances, it is plausible to infer that just as the Stomach channel conveys nourishment from the Spleen to the muscles, the Gallbladder channel transmits the Yin and Blood from the liver to support the sinews, and thereby relax them. Therefore, GB-34 may be utilized in instances of Kidney or Liver Yin deficiency to either enhance the liver's ability to nourish the tendons with Yin and Blood or to restore normal flow within the liver-gallbladder channels, which could manifest as generalized stiffness or symptoms indicative of hyperactivity. In cases of an overactive Liver and Gallbladder, stimulating the Back-shu points may also yield beneficial effects. The benefits of addressing the shaoyang-jueyin system were demonstrated in the chapter regarding the liver.

Muscles are particularly significant in the initial phases of CS, and especially in CS of the neck type. The influence of Tuina on muscle functionality has been briefly examined from a Western medical perspective. Given that muscles are associated with the Spleen, the incorporation of ST-36 as an auxiliary acupuncture point appears essential, alongside other relevant points. A dysfunction of the Spleen is linked to the accumulation of dampness; however, due to the chronic nature of dampness as a pathogenic factor, its management necessitates considerable time and effort. Therefore, in the context of CS, a more effective approach would involve local mobilization of dampness and the stimulation of qi flow within the cervical meridians, as well as the upper back meridians (Gallbladder and Small Intestine) and the entire bladder meridian through Tuina and/or moving cupping. Another therapeutic approach related to Spleen deficiency involves not only the general tonification of qi and blood but also the reinforcement of the body's exterior, utilizing points such as LI-4 or LU-7. Notably, LU-7, as the command point for the neck, enhances blood flow in the vertebral artery, [134] making it a valuable distal point for tonifying Wei-qi and alleviating qi and blood stagnation in the neck.

8.4. Tuina Treatment of CS

8.4.1. Sinew-Bone Theory

CS has been examined in terms of constitution, pathogen accumulation, and the Zang-Fu, alongside the relationships with the involved tissues. Nevertheless, these perspectives fail to account for the functional state of the tissues, which primarily encompasses motion and balance. Consequently, Tuina therapy employs the Sinew-Bone theory as a foundational principle in addressing CS and other musculoskeletal disorders. The Sinew-Bone theory encompasses the functions of the tissues that facilitate the overall balance and movement of the body, with particular emphasis on the spine, which serves as the structural basis for stability.[135] In the context of CS, "Bone" pertains to the vertebral bodies and articular processes, while "Sinew" encompasses tendons, joints, muscles (and associated muscle channels), fascia, nerves, blood vessels, and cartilage. [136] This framework emphasizes the dynamic interplay among the five tissue types.

Zhu[137] conceptualizes spinal stability as comprising two components: endogenous stability, which is the static balance provided by intervertebral bodies, intervertebral disks, and ligaments, and exogenous stability, which is the dynamic balance governed by muscular activity. The relationship between these two forms of stability is such that the dynamic

balance of the muscles influences the static balance of the spine. This understanding aligns with the phenomena observed in the progression of CS, where a disruption in the regulation of dynamic balance—due to muscle stress, weakness, or fatigue from aging or other factors—can result in cervical spine instability, as seen in AAI,[138] or serve as a precursor to the development of CSR.

These foundational theories highlight the functional interconnections among tissues, paralleling the Zang-Fu theory's exploration of internal organ relationships, and serve as a framework for Tuina treatment of cervical spine conditions. Consequently, to determine the most suitable treatment approach, it is essential to assess and address each component of the sinew-bone equilibrium and elucidate their roles in various clinical presentations. Such assessments are crucial for understanding the interplay between the dynamic and static balance of the cervical spine.

8.4.2. Spinal Balance and Relationship to Treatment

Numerous perspectives advocate for the treatment of all spinal segments, including the pelvis, lower knees, and ankles in the context of spinal disorders. Shi [139] through the concept of spine pivot theory, posits that alleviating issues in the hip, knee, and ankle joints associated with spinal diseases can influence the spinal curvature and alter stress distributions within the spine, thereby enhancing treatment efficacy. Similarly, Zhang[140] suggests that concurrent treatment of the cervical, thoracic, and lumbar regions is essential for addressing cervical pathologies. Consequently, it is crucial to consider the overall balance of the spine when evaluating and managing CS.

The sagittal balance of a healthy spine represents the physiological alignment achieved through muscular actions in an energy-efficient manner.[141] Thus, akin to the sinew-bone theory, any failure of the muscles to sustain this balance can lead to instability, compromising the maintenance of sagittal alignment and resulting in complications. This notion is supported by evidence demonstrating the impact of both global and local musculature on segmental stability. [142] Goel[137] further asserts that instability related to muscular deficiencies can precipitate degenerative changes. When muscle strength is compromised, leading to an inability to adequately support the spine, compensatory adjustments in sagittal orientation occur, initially affecting adjacent segments before potentially propagating further.[143] Research indicates that the sagittal misalignment of the spine is predominantly is strongly related to the thoracic spine. A study involving healthy adults and patients with cervical disk degeneration, demonstrated a correlation between cervical sagittal alignment and thoracic alignment.[144] In a separate analysis by Berthonnaud et al.,[145] which examined sagittal balance parameters in 160 asymptomatic young adults, a notable interdependence between spinal and pelvic parameters was identified, underscoring the importance of the spine-pelvis relationship in cervical spine alignment.

The loss of lumbar lordosis (LL) is particularly associated with degenerative conditions,[140] especially in patients under 45 years old presenting with disk herniation and degenerative disks. This loss prompts compensatory mechanisms in the pelvis, leading to posterior rotation, which in turn reduces thoracic kyphosis to preserve alignment. Consequently, this adjustment causes the head and neck to tilt backward to maintain a horizontal gaze.[142] Additionally, the implications of LL loss extend below the waist, manifesting as knee flexion[146] and ankle extension,[147] alongside potential tenderness and restricted range of motion, often accompanied by tightness in the gluteal[148] and hamstring muscles.[149]

The absence of lumbar lordosis (LL) is not the sole contributor to cervical deformities. A study involving 470 patients with thoracolumbar spinal deformities, classified according to the SRS-Schwab criteria and averaging 52 years of age, revealed that 53% exhibited either

cervical kyphosis or cervical hyperlordosis. [150] This condition may correlate with alterations in lumbar lordosis. The research identified a link between thoracic deformity and cervical kyphosis, which was present in 49% of the cases; however, no correlation was established with cervical hyperlordosis. In instances of cervical hyperlordosis, characterized by an increased forward head posture (FHP), there is a noted flexion in the subaxial cervical spine coupled with an extension in the upper cervical spine,[151] which serves to maintain a horizontal gaze, as the C1-C2 segment plays a crucial role in cervical lordosis.[152] Furthermore, FHP may arise from thoracic hyperkyphosis, which tends to reduce the foraminal area at the C5-C7 segments, particularly at C5-C6[153] due to the extension, prompting a compensatory increase in cervical lordosis to enhance the cervical foraminal areas. Regardless of whether FHP is a primary condition or a secondary effect of thoracic pathology, numerous studies indicate that thoracic manual therapy or manipulation can yield beneficial outcomes for patients experiencing neck pain or FHP. A comparative analysis of upper cervical versus thoracic mobilization in 32 individuals with FHP demonstrated significant improvements in craniovertebral angle (CVA), cervical range of motion, numeric pain rating scale (NPRS), pressure pain threshold, neck disability index (NDI), and global rating of change (GRC), with these benefits persisting at a four-week follow-up. [154] Additionally, another study involving patients with neck pain found that a combination of upper cervical and cervico-thoracic junction mobilization led to enhanced range of motion (ROM) in extension and right rotation, as well as a reduction in the electromyographic (EMG) amplitude of the sternocleidomastoid (SCM) and anterior scalene muscles, compared to interventions focused solely on the upper cervical level, with both approaches proving equally effective in improving cervical alignment.[155] Hence, it is essential to evaluate the impact of thoracic deformities and malalignments, particularly in cases of thoracic hyperkyphosis or cervical hyperlordosis, and to integrate manipulative techniques such as bone setting and mobilizations of the thoracic spine into treatment.

Adult spinal deformities can manifest as various combinations of spinal irregularities,[156] as in the example of swan neck deformity, which features upper cervical lordosis alongside subaxial cervical kyphosis. Exploring the intricate relationship between these deformities can yield valuable insights for enhancing the treatment of cervical spine conditions through Tuina therapy. Firstly, it is important to recognize that spinal deformities often lead to muscle fatigue therefore, in regions exhibiting such deformities—whether sagittal or coronal—therapeutic interventions should focus on rehabilitating the local musculature. Techniques such as rolling, kneading, one-finger meditation, and pressing can be employed to alleviate adhesions and tension points. Secondly, the choice of treatment modalities, including Tuina manipulations, bone-setting techniques, or passive movements, is influenced by the specific areas affected. In addition to the thoracic spine, a thorough assessment of spinal balance and compensatory mechanisms should be included in the initial evaluation. For cases involving the lumbar region, pelvis, and lower extremities, manipulative techniques should aim to release muscle tension and restore balance and range of motion through passive movements in these areas. When addressing thoracic and cervical issues, treatment protocols should be adjusted accordingly.

Lastly, it is crucial to acknowledge that not all factors contributing to these conditions are degenerative, which necessitates a nuanced approach to treatment and enables practitioners to provide more effective guidance to patients in correcting these imbalances. Exercise and postural training play a pivotal role in the management of neck pain, [157] with more targeted interventions yielding superior outcomes.

The relationship between the cervical and lumbar regions is crucial in the context of CS, both from a meridian and anatomical standpoint. In Traditional Chinese Medicine (TCM), a deficiency in kidney function can adversely affect bone health, with the lumbar region being

the anatomical site of the kidneys. This connection elucidates the frequent identification of pressure points in the lumbar area. Moreover, the Du mai meridian traverses the spine and is intricately linked to the Bladder meridian, which houses the back-shu points of various organs. These points may exhibit tenderness depending on the qi and blood status of the organs. Consequently, a comprehensive palpation of the Du mai and Bladder meridian is recommended in cases of CS to identify areas requiring unblocking. For this assessment, the spinal three-finger palpation technique should be utilized, positioning the middle finger along the midline while the index and ring fingers are placed on either side.

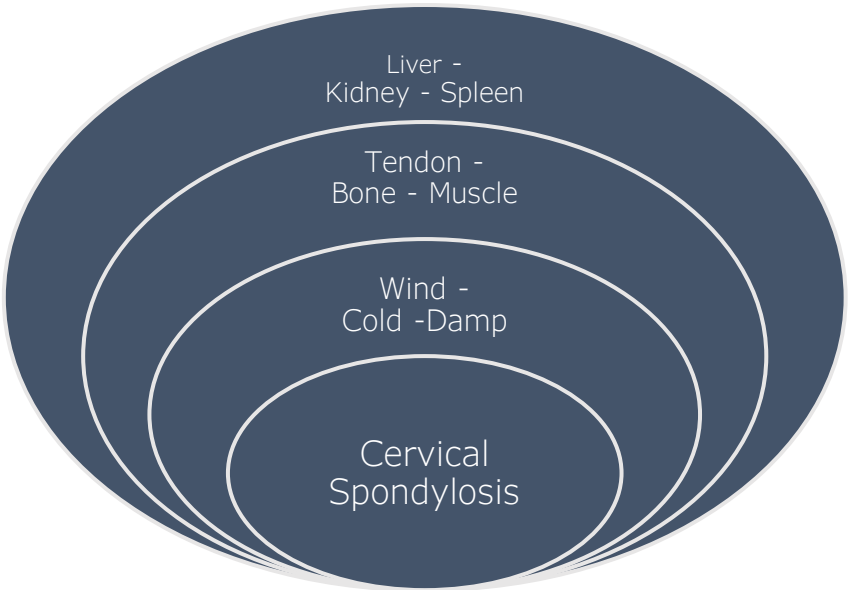

Figure 2: Factors involved in CS manifestation

8.5. Regarding the Tuina Treatment Of CS

8.5.1. Pulling Vs. Rotating

Pulling manipulations have been documented extensively in the present literature, coming with recommendations for their application in certain types of CS by Chinese medical practitioners. [138 , 136, 135, 158] Factors influencing the decision to employ these manipulations have been previously discussed. Notably, risk factors that elevate the likelihood of adverse events include smoking, being female, and the presence of comorbidities such as osteoporosis. Age is a critical factor as well, given that patients may exhibit no symptoms while harbouring degenerative changes in the cervical spine that may go unnoticed by the practitioner, or by imaging.

The progression of degenerative instability can be categorized into three distinct phases: the dysfunction phase, characterized by neck pain without observable degenerative signs; the instability phase, where degenerative changes such as disc space narrowing and facet degeneration manifest, leading to more chronic complaints; and the re-stabilization phase, during which compensatory changes result in reduced mobility and stiffness.[31] Research utilizing finite element modeling of the spine indicates that adjustment forces can exacerbate stress in high-risk areas. [159] Consequently, it is advisable to apply pulling, or thrust

manipulations, judiciously in patients with chronic conditions and among the elderly. In light of this, the most effective and safest approach would involve ceasing its use once the desired therapeutic outcome is achieved, as was observed in the present studies. Following that or acting as a substitute, passive movement has demonstrated beneficial effects and may serve as an alternative to pulling for enhancing tendon mobility and restoring the dynamic balance of the spine.

8.5.2. Unblocking the Occipital Muscle & Tendons Is Necessary in All CS Types

As previously mentioned, the atlantoaxial joint plays a crucial role in cervical lordosis and rotation, significantly contributing to various compensatory mechanisms that help maintain a horizontal gaze across different scenarios. A study examining the cervical and overall spinal alignment in Chinese patients with CS revealed that the Oc-C2 segments compensates in all individuals, irrespective of their spinal Roussouly sagittal classification.[160] In younger patients, stiffness was observed in the occipitoatlantal (Oc-C1) joint, which researchers attribute to FHP and habitual postural tendencies.[161] Additionally, an analysis of X-rays from patients with CS VAT and CSR indicated that both groups exhibited disorders in atlantoaxial joint flexion and extension; however, the flexion disorder was more pronounced in VAT patients, while CSR patients showed greater issues with Oc-C1 extension.[162]

Given the significant involvement of the occipital muscles and tendons in most types of CS, treatment strategies should focus on alleviating muscle tension. This approach should encompass the arc of GB-20-BL10-GV16-BL-10-GB20, while also incorporating GV-15 due to its anatomical proximity to the C1-C2 vertebrae. Furthermore, it is essential to address any tender points located on the semispinalis capitis and splenius capitis, which are situated just above GV-16 on the occiput. Additionally, considering the motion restrictions present in these cases, it is important to facilitate the release of affected joints through passive movements, provided that atlantoaxial instability (AAI) is not a concern. Traction techniques can also be beneficial in relieving muscle tension and enhancing joint mobility.[163]

8.5.3. Treatment of The Thoracic Area

The rationale behind addressing any misalignment of the thoracic area was substantiated in the section regarding the influence of the sagittal balance of the spine. Regardless of any misalignment of the thoracic curvature, relieving any muscle tension in the thoracic area (T1-T12) would very much benefit patients especially in individuals with FHP,[153] so when aiming to unblock the muscles and restore spinal balance, treatment should also extend to this area.

8.6. Suggested Procedures According to CS Types

8.6.1. Efficiency of A Standard Procedure

The literature reviewed indicates that the treatment of CS is most effective when it employs a variety of modalities and techniques. This encompasses not only the integration of Tuina and acupuncture but also the diverse manipulative techniques within Tuina itself, such as pulling, pressing, and traction. Given the wide variability in patient presentations, which may

include numerous combinations of postural habits, internal imbalances, and musculoskeletal alterations, it is essential to adhere to the holistic principles of TCM. This necessitates the development of a flexible treatment protocol that can be tailored to individual patients. Each case presents unique treatment priorities, and the patient's condition dictates the selection of techniques employed.

However, it is very difficult to suggest a treatment protocol that will include both Tuina and acupuncture and cover the multitude of patients' presentations. The suggested procedure then is based on the insights from this review, taking Tuina as the primary TCM modality and addresses CS according to type. Its focus is to provide with the bare essential recommendations for treatment, and a solid foundation of a CS treatment. Techniques proposed are meant to be used in the type of CS ascribed to but not necessarily performed all at once.

8.6.2. Imaging Vs. No Imaging

The utilization of imaging examinations significantly enhances the practitioner's ability to gain a comprehensive understanding of the underlying pathology, thereby facilitating the development of a more precise treatment strategy. This precision allows for adjustments and manipulations to be tailored specifically to the affected area. The greater the specificity of the adjustment, the more effectively it can target the compromised segment, which may lead to improved outcomes.[136] Furthermore, imaging provides practitioners with a more accurate assessment of tissue conditions, enabling them to discern the limitations and potential interventions available for each patient. However, access to such imaging information is not universally available in TCM clinics. Consequently, while the advantages of imaging data are acknowledged, it is prudent to proceed without relying on their availability. The procedures described below will therefore be formulated without consideration of imaging data, although it is advisable to incorporate such information whenever possible prior to treatment.

8.6.3. Initial Assessment

Before commencing treatment, after the accounting of symptoms and the interview with the patients, according to the principles of the sinew-bone theory and current literature the evaluation of the dynamic and static balance of the spine should be performed. This includes

- Assessment of the range of motion of the cervical spine, which includes approximate values for flexion (80°), extension (50°), left and right extension (45°) and rotation (80°), and look for any restrictions to the range of motion or any signs of pain, tightness, that will indicate the problematic area.
- Palpation of the cervical spine and the whole back and shoulders which includes the areas surrounding the points of GB-21, GV-14. Muscular contractions and spasms around the cervical spine that may be indicative of loss of stationary balance (segmental instability, herniation) which is compensated by the muscular contraction, or muscular weakness.
- Assessment of the global balance of the spine. Check the thoracic spine for scoliosis, hyper- or hypo-kyphosis, the lordosis of the lumbar spine, and for any presence of compensatory mechanisms, like a pelvic tilt (i.e. with the pelvic tilt test), pelvic misalignment, knee flexion, tightness of the hamstrings, and ankle extension, to ascertain whether these areas should be included in treatment.

- Assess the bladder sinew channel on the back and check for any muscular contractions that indicate compensations of bad posture with 3-finger palpation method.
- Palpate the cervical transverse processes and compare both sides of the spine for any signs of displacement
- Perform the standard physical examinations according to symptoms (i.e. Spurling's test)

8.6.4. Procedure for CS Of The Neck Type

Neck type CS is primarily characterized by muscular overexertion, fatigue, or weakness, which disrupts the dynamic equilibrium of the spine, ultimately resulting in instability. This perspective aligns with both the previously discussed WM viewpoint and the sinew-bone theory, as it effectively illustrates the interrelationship between muscles and bones.[134,157] The failure of the musculature to maintain spinal stability leads to the formation of muscle lesions, identified as Ahsi points. A study investigating the localization of these lesions in individuals with cervical type CS revealed a concentration primarily around SI-13 (the most common site) extending to the inner corner of the scapula, GB-21, GV-14, and the transverse processes of C3-C5. These regions warrant examination for the presence of Ahsi points, which should be addressed through techniques such as Tuina or acupuncture. Given that Ahsi points are predominantly located in areas associated with the Small Intestine muscle channel, assessing SI-9, SI-10, and SI-11 for tenderness may offer valuable insights for treatment. The Small Intestine channel uniquely traverses the scapula, providing attachment to the levator scapulae muscle, which originates from the cervical spine, as well as the rhomboid and serratus posterior muscles that primarily connect to the thoracic spine. A randomized controlled trial involving 46 patients with neck pain demonstrated that incorporating scapulothoracic mobilization into physical therapy yielded superior outcomes compared to physical therapy alone.[164] Additionally, another randomized controlled trial comparing neck training with and without scapular stabilization training (SST) indicated that the SST group experienced more pronounced improvements in pain reduction, forward head posture, and cervical ROM.[153] Further support for the efficacy of scapular stabilization exercises in alleviating neck pain is provided by a systematic review.[165] From the perspective of meridian therapy, examining the Small Intestine meridian in the vicinity of the scapular region for Ahsi points, along with mobilizing the scapula, can enhance treatment efficacy. Sun Wuquan[157] concludes his approach to neck type CS by applying pressure to point SI-11, which is justified by its role as a connection between the scapula and the back, making it a valuable addition to the treatment protocol.

To conclude, the main principles that guide the treatment of neck type CS would be to unblock the sinew channels and the collaterals, restore the balance between muscles and joints by unblocking the tendons in the cervical spine, and restore the static balance of the spine. To achieve these objectives, the following procedural recommendations are proposed.

(With intensity from soft to hard)

Patient in a prone position

- Lifting-grasping the cervical spine

- One-finger meditation/Kneading the Bladder and Du meridians on the neck
- One-finger meditation/Kneading/ the arc from GB-20 on one side, through to BL-10, GV-16, GV-15, to BL-10 and GB-20 on the opposite side.
- One-finger meditation/Kneading/Pressing-kneading the lower occipital area.
- Pressing/Pressing-kneading/Kneading GB-20, BL-10, GV16
- Plucking to release the tendons on the cervical spine.
- Rolling/Kneading the shoulders, upper back, and scapula all the way to the mid thoracic area (approximately to the lower border of the scapula)
- Pressing-kneading C7-T10 Jiaji
- Pressing-kneading the area that covers SI-15 to SI-12 (top of scapula) and the meridians on it. Digital-press any Ahsi points for 30s-1min. each.
- One finger meditation on SI-9 and SI-10, press SI-11, and rotate the scapula

Patient lies supine

- Stretch neck to the side.
- Finger-kneading on the side of the neck, on the neck muscles and the sternocleidomastoid.
- Repeat on other side.
- Finger kneading under the occiput
- Traction (both with the neck straight and turned on each side)

Patients in a sitting position

- Digital/elbow pressing on GB-21 area and any Ahsi points
- Grasp/Lift the upper back starting from hard to soft
- Rotate or Pull the thoracic area
- Rotate or Pull the neck area
- Knead the neck
- Vibrate GV-20
- Tap/Pat the upper back, and shoulder area

8.6.5. Procedure For CSR

Attention to differentiate between postural factors and degenerative changes is crucial in understanding the symptoms associated with CSR, as this knowledge will aid in focusing the treatment. . Research indicates that myofascial trigger points are present in 60.2% of CSR patients,[166] which is something that needs to be considered, highlighting the importance of this factor in clinical considerations. It is estimated that 70-75% of CSR cases result from neural foramina narrowing, while 20-25% are attributed to disc herniation.[136] In either case, attention should be paid when using pulling manipulations due to these exact reasons, and emphasis should be place on using traction. Consequently, caution is warranted when employing pulling manipulations, with a particular emphasis on traction techniques. Although traction has been recommended for neck-type cervical spondylosis, it should be applied with greater duration and gradual intensity in CSR cases, given its heightened relevance.

In the existing literature, acupuncture is more commonly utilized than Tuina for CSR, with acupuncture targeting points along the entire meridian pathway. As previously noted, Qi and Blood deficiency is a significant contributor to CSR, necessitating a more prominent role for

acupuncture due to its influence on the main meridians. For Tuina, this understanding translates into two primary actions. First, it is essential to ensure that the joints, which serve as critical conduits for the marrow and Yang qi, remain unobstructed; thus, rotational manipulations of the shoulder, elbow, wrist, and fingers should be implemented together with stimulation of the points on those areas. Second, given that the treatment is rooted in Qi and Blood deficiency, the Yangming meridian of the arm, rich in Qi and Blood, becomes particularly relevant, especially in cases of atrophy.[167] Therefore, stimulating Yangming points around the major joints and facilitating the movement of Qi and Blood within the Yangming sinew channel should be integral to the treatment approach for CSR.
The treatment principle added to the previous ones, would be to help the movement of Qi through the joints. Considering the above, the following procedures are recommended in addition to or in modification of the neck type procedure

- Traction
- Rolling/Kneading from elbow to arm.
- Digital/elbow pressing of trigger points (if applicable)
- Plucking the tendons of the shoulder and elbow.
- Rotating the shoulder, elbow, wrist, and fingers.
- Pressing/Kneading points of the affected meridian on the hand, elbow, and shoulder.
- Foulaging the arm
- Shaking the arm

8.6.6. Procedure For CS VAT

Symptoms indicative of vertebrobasilar insufficiency should raise concerns regarding the potential presence of atlantoaxial instability (AAI), which may arise from either muscular or degenerative conditions. Anomalies of the vertebral artery are frequently observed in individuals with AAI thus, palpation of the atlantoaxial transverse process in the GB-20 region may help determine the presence of such anomalies. The vertebral artery emerges at the C1 level and subsequently curves to penetrate the occiput, rendering it susceptible to abnormal positioning of the atlas. In such instances of instability, this may lead to a distortion of its structure. Additionally, dysfunction of the mechanoreceptors that facilitate head proprioception may occur, potentially triggered by spasms in the deep segmental upper cervical muscles, which can arise from disuse, weakness, or the instability itself. Furthermore, degeneration may stimulate sympathetic nerve fibers, leading to vasoconstriction of the vertebral artery.[168] Additionally, persistent sub-occipital pain may suggest degeneration at the occipito-cervical junction (Oc-C2),[37] serving as another potential distinguishing characteristic. Given that the atlantoaxial joint plays a crucial role in cervical rotation, any exacerbation of symptoms during head rotation should indicate possible involvement of this joint.
According to Professor Yin Keijing, cervical spondylotic vertebrobasilar insufficiency (CS VAT) is more prevalent among middle-aged and elderly populations, which complicates long-term prognoses.[169] This observation cautions against the application of excessive adjustment forces, advocating instead for gentle passive movements, which may be challenging due to the increased spinal stiffness often present in older patients. A cohort study involving 3,638 patients conducted by Chang et al. revealed a minimal risk of cervical vertigo among individuals with CS.[170] In a comparative analysis by Shende et al., patients with CS who experienced vertigo exhibited a higher osteophyte score and a greater degree of degeneration than those without vertigo.[171] Consequently, the presence of dizziness or vertigo

is primarily linked to the existence of osteophytes, although it is important to note that herniated discs may also contribute,[172] as well as atlantoaxial instability.[173] Given that the disease stage correlates with these observations, it may serve as an indicator for the underlying cause of vertigo. Osteophyte compression may also cause oedema which comes in direct contact with the vertebral artery.[169] Therefore, based on the incidence of degeneration presented previously, when aged patients present with vertigo it would seem reasonable to assume the existence of osteophytes.

Professor Yin further emphasizes the importance of considering potential underlying cardiovascular issues when developing treatment plans. In cases presenting with dizziness, it is essential to rule out purely cardiovascular causes. Depending on the specific circumstances, a referral to a general practitioner for imaging studies and/or cardiovascular assessments may be warranted to differentiate between cervicogenic and cardiovascular origins of the symptoms.

Considering the previous then the following procedures are recommended in addition to or in modification of the previous steps.

- AA joint stabilization (using i.e. the one-point, two surface method)
- One finger meditation on GV-20, Sishencong, Taiyang
- Digital pressing GB-20, GV-17, GB-19
- Sweeping the temporal area
- Grasping five meridians
- Pushing Qiaogong
- Vibrating GV-16, GV-20

9. CONCLUDING REMARKS

The present review attempted to shine light on the underlying mechanisms and principles governing the use of acupuncture and Tuina for the treatment of CS, with the objective is to clarify the parameters and conditions that inform their utilization, thereby enhancing the efficacy and safety of treatment. Evidence suggests that Tuina is effective in addressing CS, with its efficacy being augmented by acupuncture, and vice versa. Their combination can provide a comprehensive conservative treatment approach which in some cases will benefit by herbal medicine supplementation. However, it is important to note that the reliance on a single reviewer presents a significant limitation to the overall quality of this analysis.

Nonetheless, the management of CS must invariably prioritize two critical components: rest and exercise. It is posited that no effective treatment regimen can be established without incorporating exercise. A substantial body of evidence underscores the importance of these elements.[156, 35] Specifically, when considering exercise, it is crucial to focus on the training of the deep cervical flexors.[7] If possible, activities that enhance proprioception should be encouraged, as improvements in proprioceptive abilities have been associated with symptom relief in patients suffering from neck pain. [174] Qi gong exercise has also shown positive effects on neck pain,[175] and are recommended due to their positive impact on overall postural alignment.

Finally, it is essential to consider the psychological state of the patient and their attitude towards their condition, as research indicates that negative expectations can adversely influence both pain perception and treatment outcomes. [176,177,178] Providing support through Tuina and acupuncture, alongside education about the condition and encouragement towards proactive measures for improvement, is vital.

Given the diverse presentations of patients with CS, a more nuanced exploration of treatment strategies tailored to individual types, constitutions, and syndrome differentiation is warranted to establish more precise guidelines for appropriate interventions in each case. The present work can be regarded as a tool for the integration of many available methods into the clinical practice, and as such, may prove useful to practitioners of TCM.

References

[1] https://www.ncbi.nlm.nih.gov/books/NBK551557/
[2] GBD 2021 Neck Pain Collaborators. Global, regional, and national burden of neck pain, 1990–2020, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021. *The Lancet Rheumatology.* 19 March 2024. doi: 10.1016/S2665-9913(23)00321-1.
[3] Hurwitz EL, Randhawa K, Yu H, Côté P, Haldeman S. The Global Spine Care Initiative: a summary of the global burden of low back and neck pain studies. Eur Spine J. 2018 Sep;27(Suppl 6):796-801. doi: 10.1007/s00586-017-5432-9. Epub 2018 Feb 26. PMID: 29480409.
[4] Takagi, I., Eliyas, J., & Stadlan, N. (2011). Cervical spondylosis: an update on pathophysiology, clinical manifestation, and management strategies.. *Disease-a-month : DM*, 57 10, 583-91 . https://doi.org/10.1016/j.disamonth.2011.08.024.
[5] Kushchayev, S. V., Glushko, T., Jarraya, M., Schuleri, K. H., Preul, M. C., Brooks, M. L., & Teytelboym, O. M. (2018). ABCs of the degenerative spine. *Insights into imaging*, *9*, 253-274.
[6] Joseph, R., & Roy, F. (2023). Prevalence of Cervical Radiculopathy among Information Technology Professionals with Neck Pain. *Indian Journal of Pain*, *37*(3), 169-172.
[7] Gupta, B. D., Aggarwal, S., Gupta, B., Gupta, M., & Gupta, N. (2013). Effect of deep cervical flexor training vs. conventional isometric training on forward head posture, pain, neck disability index in dentists suffering from chronic neck pain. *Journal of clinical and diagnostic research: JCDR*, *7*(10), 2261.
[8] Lin, H., Chen, X., Zhang, G., & Wu, X. (2012). The preliminary study of the mechanism and efficacy of non-steroidal anti-inflammatory drug treatment on nerve root type cervical spondylosis. *African Journal of Pharmacy and Pharmacology*, *6*(32), 2389-2392.
[9] Salvo, F., Antoniazzi, S., Duong, M., Molimard, M., Bazin, F., Fourrier-Réglat, A., Pariente, A., & Moore, N. (2014). Cardiovascular events associated with the long-term use of NSAIDs: a review of randomized controlled trials and observational studies. *Expert Opinion on Drug Safety*, 13, 573 - 585. https://doi.org/10.1517/14740338.2014.907792.
[10] Wehling, M. (2014). Non-steroidal anti-inflammatory drug use in chronic pain conditions with special emphasis on the elderly and patients with relevant comorbidities: management and mitigation of risks and adverse effects. *European Journal of Clinical Pharmacology*, 70, 1159 - 1172. https://doi.org/10.1007/s00228-014-1734-6.
[11] Thoomes, E. J. (2016). Effectiveness of manual therapy for cervical radiculopathy, a review. *Chiropractic & manual therapies*, *24*, 1-11.
[12] Kasumovic, M., Gorcevic, E., Gorcevic, S., & Osmanovic, J. (2013). Cervical syndrome–The effectiveness of physical therapy interventions. *medical archives*, *67*(6), 414.
[13] Textbook of Traditional Chinese Medicine: Volume 2: Chinese Materia Medica, Prescription, Acupuncture and Moxibustion, Other Therapies and Common Diseases. (2024). Γερμανία: Springer Nature Singapore, Imprint: Springer.
[14] Flaws, B., Sionneau, P. (2001). The Treatment of Modern Western Medical Diseases with Chinese Medicine: A Textbook & Clinical Manual. USA: Blue Poppy Press.
[15] Unschuld, P. U. (2016). Huang Di Nei Jing Ling Shu: The Ancient Classic on Needle Therapy. Ηνωμένες Πολιτείες: University of California Press.
[16] Huangfu, M., Yang, S., Chace, C. (1994). The Systematic Classic of Acupuncture & Moxibustion. Ηνωμένες Πολιτείες: Blue Poppy Press.
[17] Wang, Q. (2007). Yi Lin Gai Cuo: Correcting the Errors in the Forest of Medicine. Ηνωμένες Πολιτείες: Blue Poppy Press.
[18] Wang, H., Zhu, Z., Wang, P., & Fu, B. (2021). Analysis on the medication rule of famous old tcm doctors in the treatment of cervical spondylosis based on data mining. *Journal of Clinical Medicine Research*, *2*(1), 142-146.
[19] Unschuld, P. U., Tessenow, H. (2011). Huang Di Nei Jing Su Wen: An Annotated Translation of Huang Di's Inner Classic – Basic Questions: 2 Volumes. Ουκρανία: University of California Press.
[20] B. (2016). Nan Jing: The Classic of Difficult Issues. Ηνωμένες Πολιτείες: University of California Press.
[21] Zhu, W. J. (2017). Clinical effect observation on liver-regulating and blood-tonifying acupuncture for cervical spondylosis of vertebral artery type. *Journal of Acupuncture and Tuina Science*, *15*(5), 382-386.
[22] Sun, P. (2010). The Treatment of Pain with Chinese Herbs and Acupuncture E-Book. United Kingdom: Elsevier Health Sciences.
[23] Ahmed, S. B., Qamar, A., Naz, A. S., Raza, I., Saeeduddin, M. F., & Fatimee, S. (2020). Factors Influencing Cervical Spondylosis. *Pakistan Journal of Medicine and Dentistry*, *9*(2), 32-38.
[24] Binder, A. I. (2007). Cervical spondylosis and neck pain. *Bmj*, *334*(7592), 527-531.
[25] Jeffreys, R. (1991). Cervical spondylotic myelopathy. *Neurocirugia*, 2, 194-197. https://doi.org/10.1016/S1130-1473(91)71144-5.

[26] Ferrara, L. A. (2012). The biomechanics of cervical spondylosis. *Advances in orthopedics*, *2012*(1), 493605.
[27] Di Lella, G. M., Costantini, A. M., Monelli, E., Guerri, G., Leone, A., & Colosimo, C. (2022). Diagnostic Imaging in the Degenerative Diseases of the Cervical Spine. In *Cervical Spine: Minimally Invasive and Open Surgery* (pp. 33-61). Cham: Springer International Publishing.
[28] Shedid, D., & Benzel, E. C. (2007). Cervical spondylosis anatomy: pathophysiology and biomechanics. *Neurosurgery*, *60*(1), S1-7.
[29] Theodore, N. (2020). Degenerative cervical spondylosis. *New England Journal of Medicine*, *383*(2), 159-168.
[30] Kaiser, M. G., Haid, R. W., Shaffrey, C. I., & Fehlings, M. G. (Eds.). (2018). *Degenerative Cervical Myelopathy and Radiculopathy: Treatment Approaches and Options*. Springer.
[31] Muto, M., Giurazza, F., Guarnieri, G., Izzo, R., & Diano, A. (2016). Neuroimaging of spinal instability. *Magnetic Resonance Imaging Clinics*, *24*(3), 485-494.
[32] Goel, A. (2021). Indicators of atlantoaxial instability. *Journal of Craniovertebral Junction and Spine*, *12*(2), 103-106.
[33] Izzo, R., Popolizio, T., D'Aprile, P., & Muto, M. (2015). Spinal pain. *European Journal of Radiology*, *84*(5), 746-756.
[34] Goel, A. (2015). Vertical facetal instability: Is it the point of genesis of spinal spondylotic disease?. *Journal of Craniovertebral Junction and Spine*, *6*(2), 47-48.
[35] Luyao, H., Xiaoxiao, Y., Tianxiao, F., Yuandong, L., & Wang, P. (2022). Management of cervical spondylotic radiculopathy: a systematic review. *Global Spine Journal*, *12*(8), 1912-1924.
[36] Srivastav, Y., Prajapati, A., Kumar, M., & Verma, A. (2023). A Short Overview of Cervical Spondylosis, Including its Diagnosis and Current Treatment Strategies. *Journal of Advances in Medicine and Medical Research*, *35*(22), 170-188.
[37] Kelly, J. C., Groarke, P. J., Butler, J. S., Poynton, A. R., & O′ Byrne, J. M. (2012). The natural history and clinical syndromes of degenerative cervical spondylosis. *Advances in orthopedics*, *2012*(1), 393642.
[38] Siwach, R. C., Kumar, S., Kumar, M., & Kumar, M. (2016). Assessment of cranial blood flow in cervical spondylosis patients. *Indian J Clin Anat Physiol*, *3*, 460-463.
[39] Voorhies, R. M. (2001). Cervical spondylosis: recognition, differential diagnosis, and management. *Ochsner Journal*, *3*(2), 78-84.
[40] Kang, K. C., Lee, H. S., & Lee, J. H. (2020). Cervical radiculopathy focus on characteristics and differential diagnosis. *Asian spine journal*, *14*(6), 921.
[41] Thatikunta, M., & Boakye, M. (2019). Fundamentals of Cervical Neurological Exam. *Degenerative Cervical Myelopathy and Radiculopathy: Treatment Approaches and Options*, 77-87.
[42] Fan, S. T. (2018). Clinical observation on cervical chiropractic for cervical spondylosis of vertebral artery type. *Journal of Acupuncture and Tuina Science*, *2*(16), 115-119.
[43] Zhao, C. F., Liu, X. A., & Ding, Y. (2014). Effect of Chinese herbal fumigation combined with tuina on vertigo and concentrations of endothelin and calcitonin gene-related peptide in patients with vertebral artery cervical spondylosis. *Journal of Acupuncture and Tuina Science*, *12*, 335-340.
[44] Wen, X. G., Yan, Y. J., & Wu, Y. L. (2015). Intensive stimulation tuina at tender points plus medication for cervical intervertebral disc herniation. *Journal of Acupuncture and Tuina Science*, *13*(6), 377-380.
[45] Sun, Y. J., Wu, Y. C., Zhang, J. F., Li, Y., & Wang, Y. (2014). Therapeutic efficacy observation on 'setting fire on the mountain'manipulation by Lu Shou-yan for cervical radiculopathy. *Journal of Acupuncture and Tuina Science*, *12*, 331-334.
[46] Wu, J. X., & Zhi, Y. (2018). Observation on clinical effects of acupuncture plus external medicine application for cervical radiculopathy. *Journal of Acupuncture and Tuina Science*, *16*(3), 171-175.
[47] Li, D., Chen, C. Y., Zhang, W., Huang, J. Y., & Wan, R. H. (2021). Acupuncture of different stimulation for the treatment of neck type cervical spondylosis: a randomised controlled trial. *TMR Non-Drug Ther*, *4*(3), 18.
[48] Haishen, Z., Manya, W., Hong, Y., Kejun, S., & Ruiqian, G. (2024). Clinical study on treatment of cervical spondylotic radiculopathy (Qi stagnation and blood stasis syndrome) with Gao's nape needle and Shentong Zhuyu decoction. *Medicine*, *103*(14), e37382.
[49] Song, Z. Y., Zhang, Z. M., Qin, X. G., Fang, X. L., & Yao, X. Q. (2019). Treatment of neck type cervical spondylopathy with Zheng's Jin Gou Diao Yu (gold-hook-fishing) acupuncture method: a randomized controlled trial. *Journal of Acupuncture and Tuina Science*, *17*(5), 350-355.
[50] Wang, S. N., Sheng, F., Pan, Y. H., Xu, F., Wang, Z. C., & Cheng, L. (2014). Clinical study on Tuina combined with auricular point sticking for cervical radiculopathy. *Journal of Acupuncture and Tuina Science*, *12*, 230-235.
[51] Pan, G. L., Zeng, L., & Dong, X. W. (2021). Therapeutic efficacy observation of warm needling moxibustion plus spine subtle adjusting manipulation for cervical radiculopathy. *Journal of Acupuncture and Tuina Science*, *19*(6), 457-461.

[52] Xing-Xing, M. A., Hao-Cheng, T. A. N. G., Wen-Jie, X. U., & ZHANG, W. H. (2021). Clinical research of atlantoaxial instability treated with the combination of ulna-tibia needling therapy and "point-to-surface" tuina manipulation. *World Journal of Acupuncture-Moxibustion*, *31*(2), 105-109.
[53] Xu, J., Shen, Z. F., Wu, Y. J., & Bian, X. D. (2019). Clinical observation on warm needling moxibustion plus tuina for cervical spondylosis of vertebral artery type. *Journal of Acupuncture and Tuina Science*, *17*(2), 111-115.
[54] Zhu, W. M., Wu, Y. C., Zhang, J. F., & Li, S. S. (2014). Clinical study on treatment of cervical spondylotic radiculopathy by electroacupuncture plus Tuina. *Journal of Acupuncture and Tuina Science*, *12*, 49-54.
[55] Li, Y., Wu, Y. Q., Xiang, Y. Q., & Zhang, S. N. (2021). Effect of Acupuncture Combined with Tuina on Cervical Curvature and Serum Inflammatory Cytokine Levels in Patients with Cervical Spondylosis. *INDIAN JOURNAL OF PHARMACEUTICAL SCIENCES*, *83*, 205-209.
[56] Yang, J., Huang, H., Shi, J., He, C., Zhang, K., Chen, Z., ... & Liu, J. (2023). Qihuang needle therapy in senile cervical spondylotic radiculopathy. *Frontiers in Aging Neuroscience*, *15*, 1140531.
[57] https://pedro.org.au/english/resources/pedro-scale/
[58] Cashin AG, McAuley JH. Clinimetrics: Physiotherapy Evidence Database (PEDro) Scale. J Physiother. 2020 Jan;66(1):59. doi: 10.1016/j.jphys.2019.08.005. Epub 2019 Sep 11. PMID: 31521549.
[59] Wei, W. G., Dong, C. W., Hu, W. C., & Lu, Z. (2015). Clinical observation on acupuncture plus chiropractic treatment for cervical spondylosis. *Journal of Acupuncture and Tuina Science*, *13*(5), 319-323.
[60] Cui, X. J., Yao, M., Ye, X. L., Wang, P., Zhong, W. H., Zhang, R. C., ... & Wang, Y. (2017). Shi-style cervical manipulations for cervical radiculopathy: a multicenter randomized-controlled clinical trial. *Medicine*, *96*(31), e7276.
[61] Gu, C. L., Yan, Y., Zhang, D., & Li, P. (2019). An evaluation of the effectiveness of acupuncture with seven acupoint-penetrating needles on cervical spondylosis. *Journal of pain research*, 1441-1445.
[62] Lin, M., Fan, L., Liu, X., & He, L. (2014, November). Clinical study on treatment of neck type cervical spondylosis by Acupoints of Neiguan (PC6) combined with medius haemospasia. In *2014 IEEE International Conference on Bioinformatics and Biomedicine (BIBM)* (pp. 91-94). IEEE.
[63] Zhao, Y., Yu, N. T., & Lai, Z. T. (2020). Clinical study of thumb-tack needle therapy for cervical radiculopathy based on meridian differentiation. *Journal of Acupuncture and Tuina Science*, *18*(2), 129-134.
[64] Zhu, W. J. (2017). Clinical effect observation on liver-regulating and blood-tonifying acupuncture for cervical spondylosis of vertebral artery type. *Journal of Acupuncture and Tuina Science*, *15*(5), 382-386.
[65] HU, A. E., & YANG, H. Q. (2014). Comparison of efficacy between electroacupuncture and the combination of collateral bloodletting, cupping, and acupoint application for cervical spondylosis radiculopathy (CRS). *World Journal of Acupuncture-Moxibustion*, *24*(3), 25-29.
[66] Meng, X. W., Wang, Y., Piao, S. A., Lv, W. T., Zhu, C. H., Mu, M. Y., ... & Guo, Y. (2018). Wet cupping therapy improves local blood perfusion and analgesic effects in patients with nerve-root type cervical spondylosis. *Chinese journal of integrative medicine*, *24*, 830-834.
[67] Kokubo, Y., Uchida, K., Kobayashi, S., Yayama, T., Sato, R., Nakajima, H., ... & Baba, H. (2008). Herniated and spondylotic intervertebral discs of the human cervical spine: histological and immunohistological findings in 500 en bloc surgical samples. *Journal of Neurosurgery: Spine*, *9*(3), 285-295.
[68] Navone, S. E., Marfia, G., Giannoni, A., Beretta, M., Guarnaccia, L., Gualtierotti, R., ... & Campanella, R. (2017). Inflammatory mediators and signalling pathways controlling intervertebral disc degeneration. *Histology and histopathology*, *32*(6), 523-542.
[69] Lotz, J. C., Fields, A. J., & Liebenberg, E. C. (2013). The role of the vertebral end plate in low back pain. *Global spine journal*, *3*(3), 153-163.
[70] Smith, C., Kruger, M., Smith, R., & Myburgh, K. (2008). The Inflammatory Response to Skeletal Muscle Injury. *Sports Medicine*, 38, 947-969. https://doi.org/10.2165/00007256-200838110-00005.
[71] Kapoor, M., Martel-Pelletier, J., Lajeunesse, D., Pelletier, J., & Fahmi, H. (2011). Role of proinflammatory cytokines in the pathophysiology of osteoarthritis. *Nature Reviews Rheumatology*, 7, 33-42. https://doi.org/10.1038/nrrheum.2010.196.
[72] Wei-Qiang, S., & Guang-Zhi, Z. (2019). Effects of acupuncture on expression of VEGF, PLA2 and PGE2 and extracellular matrix collagen and metabolic enzymes in the intervertebral disc of rats with cervical disc degeneration. *Journal of Hainan Medical University*, *25*(17).
[73] Liu, H., Zhang, T., Liu, M., Wang, C., & Yan, J. (2021). Acupuncture delays cartilage degeneration through upregulating SIRT1 expression in rats with osteoarthritis. *Evidence-Based Complementary and Alternative Medicine*, *2021*(1), 2470182.
[74] Zheng, L., Wang, K., Li, M., Wang, J., Qiao, Y., & Li, H. (2023). Shutiao Jingjin massage can stabilize intracellular environment of rabbit chondrocytes following knee osteoarthritis-induced cartilage injury. *Chinese Journal of Tissue Engineering Research*, *27*(35), 5681.
[75] Su, X., Song, P., Meng, F., Xu, W., Xing, H., & Zhang, H. (2023). Tuina Manipulation to Reduce Inflammation and Cartilage Loss in Knee Osteoarthritis Rats. *Journal of Visualized Experiments: Jove*, (196).

[76] Jin, X., Yu, Y., Lin, Y., Yang, J., & Chen, Z. (2023). Tendon-regulating and bone-setting manipulation promotes the recovery of synovial inflammation in rabbits with knee osteoarthritis via the TLR4–MyD88–NF-κB signaling pathway. *Annals of Translational Medicine*, *11*(6).
[77] Shi, T., Liu, Y., Ji, B., Wang, J., Ge, Y., Fang, Y., ... & Wang, Y. (2023). Acupuncture Relieves Cervical Spondylosis Radiculopathy by Regulating Spinal Microglia Activation Through MAPK Signaling Pathway in Rats. *Journal of Pain Research*, 3945-3960.
[78] Da Silva, M. D., Bobinski, F., Sato, K. L., Kolker, S. J., Sluka, K. A., & Santos, A. R. (2015). IL-10 cytokine released from M2 macrophages is crucial for analgesic and anti-inflammatory effects of acupuncture in a model of inflammatory muscle pain. *Molecular neurobiology*, *51*, 19-31.
[79] Zhang, Q., Zhou, M., Huo, M., Si, Y., Zhang, Y., Fang, Y., & Zhang, D. (2023). Mechanisms of acupuncture–electroacupuncture on inflammatory pain. *Molecular pain*, *19*, 17448069231202882.
[80] Van Pelt, D. W., Lawrence, M. M., Miller, B. F., Butterfield, T. A., & Dupont-Versteegden, E. E. (2021). Massage as a mechanotherapy for skeletal muscle. *Exercise and sport sciences reviews*, *49*(2), 107-114.
[81] Ye, J. N., Su, C. G., Jiang, Y. Q., Zhou, Y., Sun, W. X., Zheng, X. X., ... & Zhu, J. (2023). Effects of acupuncture on cartilage p38MAPK and mitochondrial pathways in animal model of knee osteoarthritis: A systematic evaluation and meta-analysis. *Frontiers in Neuroscience*, *16*, 1098311.
[82] Wu, G. W., Chen, J., Huang, Y. M., Pan, C. B., Chen, W. L., Zhang, S. M., ... & Wu, M. X. (2019). Electroacupuncture delays cartilage degeneration by modulating nuclear factor-κb signaling pathway. *Chinese Journal of Integrative Medicine*, *25*, 677-683.
[83] Zhao, N., Liu, B., Liu, S. W., Zhang, W., Li, H. N., Pang, G., ... & Wang, J. G. (2021). The Combination of Electroacupuncture and Massage Therapy Alleviates Myofibroblast Transdifferentiation and Extracellular Matrix Production in Blunt Trauma-Induced Skeletal Muscle Fibrosis. *Evidence-Based Complementary and Alternative Medicine*, *2021*(1), 5543468.
[84] Yao, C., Guo, G., Huang, R., Tang, C., Zhu, Q., Cheng, Y., ... & Fang, M. (2022). Manual therapy regulates oxidative stress in aging rat lumbar intervertebral discs through the SIRT1/FOXO1 pathway. *Aging (Albany NY)*, *14*(5), 2400.
[85] Matsushita, T., Sasaki, H., Takayama, K., Ishida, K., Matsumoto, T., Kubo, S., Matsuzaki, T., Nishida, K., Kurosaka, M., & Kuroda, R. (2013). The overexpression of SIRT1 inhibited osteoarthritic gene expression changes induced by interleukin-1β in human chondrocytes. *Journal of Orthopaedic Research*, 31. https://doi.org/10.1002/jor.22268.
[86] Meng, F., Xing, H., Su, X., Xu, W., Song, P., & Gong, L. (2023). Analgesic effect of tuina on rat models with compression of the dorsal root ganglion pain. *JoVE (Journal of Visualized Experiments)*, (197), e65535.
[87] Cai, Z., Zhang, N., Ma, N., Dong, G., Wang, S., & Zhao, Y. (2016). Trend of the incidence of cervical spondylosis: decrease with aging in the elderly and increase with aging in the young and the adults. *Int J Clin Exp Med*, *9*(7), 14329-14336.
[88] Wong, S. H. J., Chiu, K. Y., & Yan, C. H. (2016). osteophytes. *Journal of orthopaedic surgery*, *24*(3), 403-410.
[89] Chengguo, S. U., Xiaoyan, Z. H. A. O., Jiangnan, Y. E., ZHANG, X., JIANG, Y., Junjie, G. U. O., ... & Jun, Z. H. U. (2023). Effect of Tuina along "bladder meridian" alleviating intervertebral disc degeneration by regulating the transforming growth factor-β1/Smad signaling pathway in a rabbit model. *Journal of Traditional Chinese Medicine*, *43*(5), 991.
[90] Wu, Y. C., Sun, Y. J., Zhou, J. H., & Li, S. S. (2011). Regulatory effects of transforming growth factor beta in electro-acupuncture treatment of knee osteoarthris. *Chinese Journal of Tissue Engineering Research*, *15*(11), 2079.
[91] Zuo, Z., Huang, P., Jiang, Y., Zhang, Y., & Zhu, M. (2019). Acupuncture attenuates renal interstitial fibrosis via the TGF-β/Smad pathway. *Molecular medicine reports*, *20*(3), 2267-2275.
[92] Wang, W. H., Zeng, Q. L., Zhang, J. J., Wu, H. S., Wu, S. B., & Zhou, M. Q. (2024). Electroacupuncture improves myocardial fibrosis in heart failure rats by attenuating ECM collagen deposition through modulation of TGF-β1/Smads signaling pathway. *Tradit Med Res*, *9*(8), 43.
[93] Guler, M. A., Celik, O. F., & Ayhan, F. F. (2020). The important role of central sensitization in chronic musculoskeletal pain seen in different rheumatic diseases. *Clinical rheumatology*, *39*, 269-274.
[94] Yücel, F. N., & Sanal-Toprak, C. (2024). Central sensitization-related symptoms and their relationship to disability in prevalent chronic musculoskeletal pain: A cross-sectional study. *Musculoskeletal Science and Practice*, *73*, 103147.
[95] Troitzsch, D., Vogt, S., Abdul-Khaliq, H., & Moosdorf, R. (2005). Muscle tissue oxygen tension and oxidative metabolism during ischemia and reperfusion.. *The Journal of surgical research*, 128 1, 9-14 . https://doi.org/10.1016/J.JSS.2004.09.014.
[96] Mense, S. (2003). The pathogenesis of muscle pain. *Current pain and headache reports*, *7*, 419-425.

[97] Dou, B., Li, Y., Ma, J., Xu, Z., Fan, W., Tian, L., ... & Lin, X. (2021). Role of neuroimmune crosstalk in mediating the anti-inflammatory and analgesic effects of acupuncture on inflammatory pain. *Frontiers in Neuroscience*, *15*, 695670.
[98] Liu, H., Wang, H., Sheng, M., Jan, L., Jan, Y., & Basbaum, A. (1994). Evidence for presynaptic N-methyl-D-aspartate autoreceptors in the spinal cord dorsal horn.. *Proceedings of the National Academy of Sciences of the United States of America*, 91 18, 8383-7 . https://doi.org/10.1073/PNAS.91.18.8383.
[99] Zhang, H., Wang, B., Chen, S., Chen, L., Jiang, J., Jiang, Y., ... & Lin, Z. (2023). Exploring the effect of Tuina on the dendritic structure of spinal cord dorsal horn in rats with lumbar disc herniation based on NR2B/PSD-95 pathway. *Journal of Acupuncture and Tuina Science*, *21*(2), 129-136.
[100] Yang, P., Chen, H. Y., Zhang, X., Wang, T., Li, L., Su, H., ... & Su, S. Y. (2023). Electroacupuncture attenuates neuropathic pain in a rat model of cervical spondylotic radiculopathy: involvement of spinal cord synaptic plasticity. *Journal of Pain Research*, 2447-2460.
[101] Harte, S. E., Harris, R. E., & Clauw, D. J. (2018). The neurobiology of central sensitization. *Journal of Applied Biobehavioral Research*, *23*(2), e12137.
[102] Holly, L. T., Wang, C., Woodworth, D. C., Salamon, N., & Ellingson, B. M. (2019). Neck disability in patients with cervical spondylosis is associated with altered brain functional connectivity. *Journal of Clinical Neuroscience*, *69*, 149-154.
[103] Li, H. L., Zhang, Y., & Zhou, J. W. (2024). Acupuncture for radicular pain: a review of analgesic mechanism. *Frontiers in Molecular Neuroscience*, *17*, 1332876.
[104] Maigne, J. Y., & Vautravers, P. (2003). Mechanism of action of spinal manipulative therapy. *Joint bone spine*, *70*(5), 336-341.
[105] Tzelnik, M., Simonovich, A., Stoychev, V., Alperovitch-Najenson, D., Ezra, D., & Kalichman, L. (2022). Uncovertebral Joints' Degeneration Prevalence and Association with Demographics and Symptoms. *SN Comprehensive Clinical Medicine*, *4*(1), 127.
[106] Ding, Q., Yan, M., Zhou, J., Yang, L., Guo, J., Wang, J., ... & Zhao, H. (2012). Clinical effects of innovative tuina manipulations on treating cervical spondylosis of vertebral artery type and changes in cerebral blood flow. *Journal of Traditional Chinese Medicine*, *32*(3), 388-392.
[107] Metcalfe, S., Reese, H., & Sydenham, R. (2006). Effect of high-velocity low-amplitude manipulation on cervical spine muscle strength: a randomized clinical trial. *Journal of Manual & Manipulative Therapy*, *14*(3), 152-158.
[108] Langevin, P., Desmeules, F., Lamothe, M., Robitaille, S., & Roy, J. (2015). Comparison of 2 manual therapy and exercise protocols for cervical radiculopathy: a randomized clinical trial evaluating short-term effects.. *The Journal of orthopaedic and sports physical therapy*, 45 1, 4-17 . https://doi.org/10.2519/jospt.2015.5211.
[109] Alonso-Perez, J. L., Lopez-Lopez, A., La Touche, R., Lerma-Lara, S., Suarez, E., Rojas, J., ... & Fernández-Carnero, J. (2017). Hypoalgesic effects of three different manual therapy techniques on cervical spine and psychological interaction: A randomized clinical trial. *Journal of bodywork and movement therapies*, *21*(4), 798-803.
[110] Tudini, F., Chui, K., Grimes, J., Laufer, R., Kim, S., Yen, S. C., & Vaughan, V. (2016). Cervical spine manual therapy for aging and older adults. *Topics in Geriatric Rehabilitation*, *32*(2), 88-105.
[111] Romeo, A., Vanti, C., Boldrini, V., Ruggeri, M., Guccione, A. A., Pillastrini, P., & Bertozzi, L. (2018). Cervical radiculopathy: effectiveness of adding traction to physical therapy—a systematic review and meta-analysis of randomized controlled trials. *Physical Therapy*, *98*(4), 231-242.
[112] Taso, M., Sommernes, J., Kolstad, F., Sundseth, J., Bjorland, S., Pripp, A., Zwart, J., & Brox, J. (2020). A randomised controlled trial comparing the effectiveness of surgical and nonsurgical treatment for cervical radiculopathy. *BMC Musculoskeletal Disorders*, 21. https://doi.org/10.1186/s12891-020-3188-6.
[113] Nikolaidis, I., Fouyas, I., Sandercock, P., & Statham, P. (2010). Surgery for cervical radiculopathy or myelopathy.. *The Cochrane database of systematic reviews*, 1, CD001466 . https://doi.org/10.1002/14651858.CD001466.pub3.
[114] Hou, P. W., Hsu, H. C., Lin, Y. W., Tang, N. Y., Cheng, C. Y., & Hsieh, C. L. (2015). The history, mechanism, and clinical application of auricular therapy in traditional Chinese medicine. *Evidence-Based Complementary and Alternative Medicine*, *2015*(1), 495684.
[115] Hui-Xin, D. I. N. G., Chun-Guang, Y. U., Ling, W. A. N. G., & Chun-Hua ZHANG, P. Y. L. (2019). Research Progress of Traditional Chinese Medicine Constitution Theory in Patients with Cervical Spondylosis. *Journal of Integrative Nursing*, *1*(2), 115-122.
[116] Peters, R., Schmitt, M., Mutsaers, B., Buyl, R., Verhagen, A., Pool-Goudzwaard, A., & Koes, B. (2023). Identifying patient characteristics associated with the occurrence of post treatment non-serious adverse events after cervical spine manual therapy treatment in patients with neck pain. *Archives of Physical Medicine and Rehabilitation*, *104*(2), 277-286.
[117] Gibbons, P., & Tehan, P. (2006). HVLA thrust techniques: what are the risks?. *International Journal of Osteopathic Medicine*, *9*(1), 4-12.

[118] Kranenburg, H. A., Schmitt, M. A., Puentedura, E. J., Luijckx, G. J., & Van der Schans, C. P. (2017). Adverse events associated with the use of cervical spine manipulation or mobilization and patient characteristics: a systematic review. *Musculoskeletal Science and Practice*, *28*, 32-38..
[119] Wang, C., Tian, F., Zhou, Y., He, W., & Cai, Z. (2016). The incidence of cervical spondylosis decreases with aging in the elderly, and increases with aging in the young and adult population: a hospital-based clinical analysis. *Clinical Interventions in Aging*, 11, 47 - 53. https://doi.org/10.2147/CIA.S93118.
[120] Radziminska, A., Weber-Rajek, M., Strączyńska, A., & Zukow, W. (2017). The stabilizing system of the spine. *Journal of Education, Health and Sport*, *7*(11), 67-76.
[121] Liu, D. (2020). Experience of Treating Cervical Spondylotic Disease by Differentiation.
[122] Yao, W., Yang, H., & Ding, G. (2013). Mechanisms of Qi-blood circulation and Qi deficiency syndrome in view of blood and interstitial fluid circulation. *Journal of Traditional Chinese Medicine*, *33*(4), 538-544.
[123] Wang, N., Niu, R., Chang, S. Y., Sun, C., Jia, H. P., Yue, G. L., & Du, G. Z. (2023). Study on the correlation between the thickness of superficial fascia at Dazhui (GV14) and cervical spondylosis. *Zhen ci yan jiu= Acupuncture Research*, *48*(4), 399-403.
[124] Long, R. (2003). Qi and yang deficiency of the liver. *The Journal of Chinese Medicine*, (71), 16-23.
[125] Elbinoune, I., Amine, B., Shyen, S., Gueddari, S., Abouqal, R., & Hajjaj-Hassouni, N. (2016). Chronic neck pain and anxiety-depression: prevalence and associated risk factors. *Pan African Medical Journal*, *24*(1).
[126] Liu, F., Fang, T., Zhou, F., Zhao, M., Chen, M., You, J., ... & Liu, Z. (2018). Association of Depression/anxiety symptoms with neck pain: a systematic review and meta-analysis of literature in China. *Pain research and Management*, *2018*(1), 3259431.
[127] Mullins, P. M., Yong, R. J., & Bhattacharyya, N. (2023). Associations between chronic pain, anxiety, and depression among adults in the United States. *Pain Practice*, *23*(6), 589-594.
[128] Vangermeersch, L. (1994). Bi-syndromes, Or, Rheumatic Disorders Treated by Traditional Chinese Medicine. Belgium: Satas.
[129] Deadman, P. (1993). The five shu-points. *JOURNAL OF CHINESE MEDICINE-HOVE-*, 31-31.
[130] Kim, S., Kim, Y. I., Sin, R. S., Rim, K. S., Pu, Y. J., Ri, K. I., ... & Kim, H. S. (2016). Study on cerebral blood flow regulatory features of acupuncture stimulation at various acupoints. *Medical Acupuncture*, *28*(6), 316-324.
[131] Weiwei, X., Kejing, Y., Min, L., & Xu, D. (2022). Professor Yin Kejing's experience in treating vertebral artery type cervical spondylosis with the method of. *Frontiers in Medical Science Research*, *4*(10).
[132] WANG, Q. C., & GU, Z. Y. (2015). The influential point of bone should be Dàzhuī (GV 14) rather than Dàzhù (BL 11). *World Journal of Acupuncture-Moxibustion*, *25*(3), 54-58.
[133] Huang, H. X., Ouyang, X. L., Zhong, G. P., Zhu, D. C., Xu, W., & Jiao, L. (2023). Manifestations and distribution rules of jingjin lesions in neck-type cervical spondylosis. *Zhongguo zhen jiu= Chinese acupuncture & moxibustion*, *43*(8), 881-886.
[134] Yao, M. A., He, B. U., Zheng, L. I. U., JIA, J. R., LI, X. Y., & XU, Y. Q. (2015). Effect of acupuncture at Lièquē (LU 7) on vertebral-basilar artery hemodynamics in patients with cervical vertigo. *World Journal of Acupuncture-Moxibustion*, *25*(2), 23-27.
[135] Fang, M., Yan, J. T., Jiang, S. Y., Sun, W. Q., & Liu, Y. C. (2008). Role of cervical soft tissue lesion in cervical spondylosis and tuina intervention. *Journal of Acupuncture and Tuina Science*, *6*(2), 75.
[136] Li, H., & Dou, Q. (2022). Application of Muscle and Bone Balance Theory in Lumbar Disc Herniation. *Front. Med. Sci. Res*, *4*(1), 23-28.
[137] Zhu, G. M., Sun, W. Q., Shen, G. Q., & Fang, M. (2007). Mechanisms of spinal micro-adjustment manipulations in treating cervical spondylotic radiculopathy. *Journal of Acupuncture and Tuina Science*, *5*, 68-70.
[138] Goel, A., Dandpat, S., Shah, A., Rai, S., & Vutha, R. (2020). Muscle weakness–related spinal instability is the cause of cervical spinal degeneration and spinal stabilization is the treatment: an experience with 215 cases surgically treated over 7 years. *World Neurosurgery*, *140*, 614-621.
[139] Shi, N. N., Shen, G. Q., Zhang, X. L., & He, S. Y. (2009). Holistic view of Chinese spinal manipulation and its clinical application. *Journal of Acupuncture and Tuina Science*, *7*, 288-292.
[140] Kai, Z., & Xin, W. (2018). Based on the theory of traditional Chinese and western medicine for the co-treatment of neck, chest, and waist. *TMR Non-Drug Therapy*, *1*(3), 87-95.
[141] Le Huec, J. C., Thompson, W., Mohsinaly, Y., Barrey, C., & Faundez, A. (2019). Sagittal balance of the spine. *European spine journal*, *28*, 1889-1905.
[142] Clark, M., & Lucett, S. (Eds.). (2010). *NASM essentials of corrective exercise training*. Lippincott Williams & Wilkins.
[143] Kim, H. J., Yang, J. H., Chang, D. G., Suk, S. I., Suh, S. W., Song, K. S., ... & Cho, W. (2020). Adult spinal deformity: current concepts and decision-making strategies for management. *Asian spine journal*, *14*(6), 886.

[144] Xing, R., Liu, W., Li, X., Jiang, L., Yishakea, M., & Dong, J. (2018). Characteristics of cervical sagittal parameters in healthy cervical spine adults and patients with cervical disc degeneration. *BMC musculoskeletal disorders*, *19*, 1-6.
[145] Berthonnaud, E., Dimnet, J., Roussouly, P., & Labelle, H. (2005). Analysis of the sagittal balance of the spine and pelvis using shape and orientation parameters. *Clinical Spine Surgery*, *18*(1), 40-47.
[146] Obeid, I., Hauger, O., Aunoble, S., Bourghli, A., Pellet, N., & Vital, J. (2011). Global analysis of sagittal spinal alignment in major deformities: correlation between lack of lumbar lordosis and flexion of the knee. *European Spine Journal*, 20, 681-685. https://doi.org/10.1007/s00586-011-1936-x.
[147] Barrey, C., Roussouly, P., Le Huec, J. C., D'Acunzi, G., & Perrin, G. (2013). Compensatory mechanisms contributing to keep the sagittal balance of the spine. *European spine journal*, *22*, 834-841.
[148] Liu, J., Huang, P., Jiang, G., Gao, L., Zhang, M., Dong, X., Zhang, W., & Zhang, X. (2022). Spinal-pelvic sagittal parameters in patients with gluteal muscle contracture: an imaging study. *PeerJ*, 10. https://doi.org/10.7717/peerj.13093.
[149] Mccarthy, J., & Betz, R. (2000). The Relationship Between Tight Hamstrings and Lumbar Hypolordosis in Children With Cerebral Palsy. *Spine*, 25, 211. https://doi.org/10.1097/00007632-200001150-00011.
[150] Smith, J. S., Lafage, V., Schwab, F. J., Shaffrey, C. I., Protopsaltis, T., Klineberg, E., ... & International Spine Study Group. (2014). Prevalence and type of cervical deformity among 470 adults with thoracolumbar deformity. *Spine*, *39*(17), E1001-E1009.
[151] Shimizu, T., Cerpa, M., & Lenke, L. G. (2021). Understanding sagittal compensation in adult spinal deformity patients: relationship between pelvic tilt and lower-extremity position. *Journal of Neurosurgery: Spine*, *35*(5), 616-623.
[152] Ogura, Y., Dimar, J. R., Djurasovic, M., & Carreon, L. Y. (2021). Etiology and treatment of cervical kyphosis: state of the art review—a narrative review. *Journal of Spine Surgery*, *7*(3), 422.
[153] Patwardhan, A. G., Khayatzadeh, S., Havey, R. M., Voronov, L. I., Smith, Z. A., Kalmanson, O., ... & Sears, W. (2018). Cervical sagittal balance: a biomechanical perspective can help clinical practice. *European Spine Journal*, *27*, 25-38.
[154] Cho, J., Lee, E., & Lee, S. (2017). Upper thoracic spine mobilization and mobility exercise versus upper cervical spine mobilization and stabilization exercise in individuals with forward head posture: a randomized clinical trial. *BMC musculoskeletal disorders*, *18*, 1-10.
[155] Kim, D. H., & Kim, S. Y. (2020). Comparison of immediate effects of sling-based manual therapy on specific spine levels in subjects with neck pain and forward head posture: a randomized clinical trial. *Disability and Rehabilitation*, *42*(19), 2735-2742.
[156] Kim, H. J., Yang, J. H., & Changes, D. (2020). Adult spinal deformity: current concepts and decision-making strategies for management. Asian Spine J. 2020; 14 (6): 886–97.
[157] Deborah Falla, Gwendolen Jull, Trevor Russell, Bill Vicenzino, Paul Hodges, Effect of Neck Exercise on Sitting Posture in Patients With Chronic Neck Pain, *Physical Therapy*, Volume 87, Issue 4, 1 April 2007, Pages 408–417, https://doi.org/10.2522/ptj.20060009
[158] Zheng, S., Xing, H., Shan, Y., Fu, Y., Li, Y., Chen, J., ... & Sun, W. (2023). Chief physician SUN Wuquan's experience collection in treating neck-type cervical spondylosis with Tuina therapy. *Journal of Acupuncture and Tuina Science*, *21*(5), 398-404.
[159] Deng, Z., Wang, K., Wang, H., Lan, T., Zhan, H., & Niu, W. (2017). A finite element study of traditional Chinese cervical manipulation. *European Spine Journal*, *26*, 2308-2317.
[160] Yu, M., Zhao, W. K., Li, M., Wang, S. B., Sun, Y., Jiang, L., ... & Liu, Z. J. (2015). Analysis of cervical and global spine alignment under Roussouly sagittal classification in Chinese cervical spondylotic patients and asymptomatic subjects. *European Spine Journal*, *24*, 1265-1273.
[161] Gong, L., Ma, H. N., Yi, P., & Tan, M. S. (2021). Flexion dysfunction of Atlanto-occipital joint associated with cervical spondylosis. *Orthopaedic Surgery*, *13*(1), 267-275.
[162] Chen, X., Xue, P., Shi, Y., & Chen, S. (2021). The Role of Digital X-Ray in Curative Effect and Nursing Evaluation of Cervical Spondylotic Radiculopathy. *Journal of Healthcare Engineering*, *2021*(1), 5666136.
[163] Fitz-Ritson, D. (1984). Therapeutic traction: a review of neurological principles and clinical applications.. *Journal of manipulative and physiological therapeutics*, 7 1, 39-49 .
[164] Shirzadi, Z., Rojhani-Shirazi, Z., & Hemmati, L. (2018). A comparison between the effects of scapulothoracic mobilization plus physical therapy with physical therapy alone in patients with mechanical neck pain: a randomized clinical trial. *Journal of chiropractic medicine*, *17*(4), 237-243.
[165] Javdaneh, N., Ambroży, T., Barati, A. H., Mozafaripour, E., & Rydzik, Ł. (2021). Focus on the scapular region in the rehabilitation of chronic neck pain is effective in improving the symptoms: a randomized controlled trial. *Journal of Clinical Medicine*, *10*(16), 3495.
[166] Kangkang, F., & Yan, C. (2023). Research progress on the use of acupuncture based on myofascial trigger point technique in the treatment of neurogenic cervical spondylosis. *MEDS Chinese Medicine*, *5*(6), 13-16.

[167] Ding, N., & Dou, Q. (2022). Treatment of Lower Limb Muscle Strength Decline after Knee Arthroplasty Based on. *MEDS Chinese Medicine*, *4*(3), 1-7.
[168] Li, Y., & Peng, B. (2015). Pathogenesis, Diagnosis, and Treatment of Cervical Vertigo Pain Physician July/August 2015; 18: E583-E595. *Pain physician*, *18*, E583-E595.
[169] Weiwei, X. Professor Yin Kejing's experience in treating vertebral artery type cervical spondylosis with the method of" three channels and one regulation.
[170] Chang, T. P., Wang, Z., Lee, X. X., Kuo, Y. H., & Schubert, M. C. (2024). Risk of Cervical Dizziness in Patients With Cervical Spondylosis. *JAMA Otolaryngology–Head & Neck Surgery*, *150*(2), 93-98.
[171] Shende, C., Rathod, T., Marathe, N., Mohanty, S., Kamble, P., Mallepally, A. R., & Sathe, A. (2023). Degenerative cervical spondylosis: a cause of vertigo?. *Global Spine Journal*, *13*(5), 1273-1279.
[172] Ujifuku, K., Hayashi, K., Tsunoda, K., Kitagawa, N., Hayashi, T., Suyama, K., & Nagata, I. (2009). Positional vertebral artery compression and vertebrobasilar insufficiency due to a herniated cervical disc.. *Journal of neurosurgery. Spine*, 11 3, 326-9 . https://doi.org/10.3171/2009.4.SPINE08689.
[173] Rong-fang, Z. (2012). Diagnosis of cervical vertigo induced by atlantoaxial joint disorder and manipulation therapy. *The Journal of Cervicodynia and Lumbodynia*.
[174] Reddy, R. S., Tedla, J. S., Dixit, S., & Abohashrh, M. (2019). Cervical proprioception and its relationship with neck pain intensity in subjects with cervical spondylosis. *BMC musculoskeletal disorders*, *20*(1), 1-7.
[175] Girard, J., & Girard, A. (2019). The effects of qigong on neck pain: a systematic review. *Complementary therapies in clinical practice*, *34*, 23-29.
[176] Weber, C., Behbahani, M., Baardsen, R., Lehmberg, J., Meyer, B., & Shiban, E. (2017). Patients' beliefs about diagnosis and treatment of cervical spondylosis with radiculopathy. *Acta Neurochirurgica*, *159*, 2379-2384.
[177] Ortego, G., Villafañe, J. H., Doménech-García, V., Berjano, P., Bertozzi, L., & Herrero, P. (2016). Is there a relationship between psychological stress or anxiety and chronic nonspecific neck-arm pain in adults? A systematic review and meta-analysis. *Journal of psychosomatic research*, *90*, 70-81.
[178] Li, S., Qi, M., Yuan, W., & Chen, H. (2015). The impact of the depression and anxiety on prognosis of cervical total disc replacement. *Spine*, *40*(5), E266-E271.