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Efficacy of Dry Needling and Acupuncture in the Treatment of Neck Pain

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Abstract

Context: Neck pain is a common phenomenon and affects a large segment of the population. Chronic neck pain, lasting more than 3 months, likely occurs in 10% - 30% of patients with acute neck pain and affects up to 288 million cases globally, carrying a significant cost in terms of quality of life, disability, and healthcare dollars. Here we review neck pain background, acupuncture and the evidence that exist to support acupuncture use in chronic neck pain.

Results: Neck pain not only affects quality of life directly, but also contributes to depression, job dissatisfaction and reduced productivity. Unfortunately, neck pain is strongly linked to office and computer work and is likely to continue increasing in prevalence. Traditional treatments, such as analgesics, physical therapy, exercise, and non-invasive therapy bring some relief, and invasive therapy is indicated if anatomical pathologies exist. Acupuncture is a form of integrative medicine, originally described and practiced in traditional Chinese medicine and now expanded to include methods including acupressure, dry needling, and others. Traditionally, it focused on restoring the patient's flow of Qi by puncturing specific points along the meridians. It has previously been shown to be effective in other forms of chronic pain and disability. Clinical trials studying acupuncture for neck pain have shown significant reduction in both pain and associated symptoms. These therapies are reviewed in this text.

Conclusions: Neck pain is a common and significant global problem. Acupuncture, dry needling, and cupping were all shown to be effective in alleviating pain both immediately after treatment, as well as provide long-lasting relief. These treatments are generally safe and inexpensive and should be considered as part of a multimodal approach for the treatment of neck pain. More head-to-head studies will provide better data to support a choice of a specific treatment over another.

Keywords: Alternative Medicine, Integrative Medicine, Chinese Medicine, Chronic Pain, Disability

1. Context

Acupuncture is the act of placing small needles into defined points on the body. These defined points of the body were characterized by ancient Chinese acupuncture practices which found these points to allow better flow of an energy known as "qi" (1). The theory is that when these points are penetrated by needles, it will open any kind of blockage that is not allowing this energy to flow correctly (2). If an individual has a blockage or an excess of this energy, this is when symptoms will start to appear and thus restoring the balance of the energy is what is thought to relieve the individual of the symptoms their body produces (2). Because of the theory that acupuncture diminishes symptoms, many studies have investigated the effectiveness of acupuncture on things like knee pain, back pain, headaches and other pain conditions, which has resulted in acupuncture being performed in medical offices and insurance companies be-

ginning to cover the procedures (2). This study has chosen to focus its efforts on the use of acupuncture for neck pain. Neck pain can be classified as non-specific or complicated. Neck pain that is classified as non-specific can be caused by a mechanical issue, such as an acceleration-deceleration movement in a motor vehicle accident, or caused by a postural mechanism (3). Furthermore, complicated neck pain affecting the cervical spine can present with neurological symptoms such as radiculopathy or myelopathy (3). In addition, neck pain can be classified into acute or chronic pain. Acute neck pain can last for weeks to months, but the pain resolves after a short period of time. Chronic neck pain is pain that last longer than 3 - 6 months and does not resolve after the acute phase; about 50% - 85% of patients with acute neck pain will go on to develop chronic neck pain (4). Neck pain is a highly prevalent disorder; in 2017, there were an estimated 288.7 million global cases (5). The 1-year incidence of neck pain was shown to be 10% - 21%, with a significant number of cases seen in office or sedentary employees (6). Different approaches exist to the treatment of beck pain, a highly prevalent disorder with significant associated disability. Here we review the evidence of acupuncture in neck pain and the efficacy of such treatments.

2. Neck Pain

Neck pain can be characterized many ways but perhaps the best method is by duration. Acute neck pain is characterized typically as lasting less than 6 weeks, subacute less than 3 months and chronic greater than 3 months.

Neck pain has a wide differential diagnosis, but most cases seen are musculoskeletal in nature. It may be difficult to isolate a single cause for neck pain as many times multiple conditions are present. This is further compounded by vague and non-specific symptoms that herald the presentation of degenerative changes (3, 7-9). A pure definition of neck pain that is only perceived from thoracic vertebrae 1 to superior nuchal line. This excludes cervical radiculopathy as this pain is felt in the arm and shoulder. This can be a confusing as cervical radicular pain comes from the neck but is perceived in the shoulder. The innervation of the structure the pain is coming from is more important than the structure itself. This is an important distinction as the approach is different depending on cause and location (10). The global burden of disease (GBD 2005) does include shoulder and upper extremity pain as many studies and reports include these causes as well. Evaluation and diagnosis criteria are centered around excluding causes that would need urgent intervention/evaluation such as trauma, tumors, neurologic infections, and certain rheumatologic conditions. If a patient presents with signs/symptoms that would indicate a serious cause they must be urgently evaluated with appropriate imaging, lab testing, or diagnostic testing to identify a specific cause (11). If a patient is not suspected of having a serious cause, then a detailed history and physical are appropriate. Many cases of neck pain in the absence of trauma or serious symptoms do not require imaging, however plain radiographs are preferred for bony injury/pathology and magnetic resonance imaging is preferred for soft tissue injury (7, 12).

Neck pain is a common complaint seen by healthcare personnel, it is estimated that the 1 year incidence of all neck pain is 10.4% and 21.3% (6). Mean prevalence is difficult to calculate as prevalence ranges can be as much as 80%. This is due to the prevalence differences in sex, occupation, location and income (6, 13, 14). Per GBD 2005 data neck pain is more prevalent in women, urban settings, and high income countries, with the highest risk age range from 35 - 49 years old (6, 13). Remission is difficult to calculate as some sources define remission as a cured state. However the GBD 2005 defines it as an asymptomatic state and found remission rates of 33% to 65% (6). While difficult to calculate it is estimated that 10% - 30% of patients with acute neck pain will develop chronic neck pain (15). Physical and psychosocial categories can be used to examine the risk factors for neck pain. Job satisfaction and general psychological health is related to neck pain prevalence with depressed mood, high stress and perceived strain being the greatest risk factors. It must be noted that chronic pain can be mood altering itself (16, 17). Positioning (most commonly reported) and neck strain levels are a large part of the physical risk factor category but level of physical activity and neck strength, mobility, and endurance also play a part in neck pain (6, 16, 17). Risk for poor recovery from neck pain include somatization, sleep difficulties female, low level education, and severity of initial neck pain (6, 18, 19). It is worth noting that many of these risk factors are modifiable.

Pain can be grouped in many ways but perhaps the most common is by clinical significance. This is broken down into serious signs/symptoms/causes and not serious signs/symptoms/causes, common causes and uncommon causes, and valid complaints or not valid complaints with overlap multiple groups. Tumors, neurologic infections, rheumatoid arthritis, ankylosing spondylitis, vasculitis, and fractures are serious but rare (10).

Triage of neck pain is based on history and physical. The Neck Pain Task force recommends neck pain should be split into 4 groups: Grade I, no signs of major pathology and no or little interference with daily activities; grade II, no signs of major pathology, but interference with daily activities; grade III, neurologic signs of nerve compression; grade IV, signs of major pathology. Blunt trauma should al-

ways be based on NEXUS criteria or Canadian C-spine rule (20).

Current treatment options for neck pain include non-invasive methods including NSAIDS, muscle relaxants, mobilization/manipulation, exercises, electromagnetic therapy/TENS, and acupuncture. NSAIDS and muscle relaxants are quite common however do not carry enough evidence to determine if they are effective and carry the risk of GI upset and drowsiness respectively (20, 21). In addition, neck pain in the absence of structural pathology/trauma is recommended to be treated with conservative therapy that is mobilization/manipulation, exercises, acupuncture and electromagnetic therapy/TENS. Manipulation, exercises, and electromagnetic therapy/TENS can cause mild transient increase in pain. These methods usually provide only short term relief (20, 22). Opioid-based therapy, whether oral, infusion or transdermal may be effective (23). In trying to avoid opioid use, cannabis has also been gaining recognition in the treatment of chronic pain (24). Infusion therapy may also include options such as ketamine, lidocaine, magnesium, and dexmedetomidine (25-30), while considering possible side effects, such as toxicity, addiction, and psychosocial harm (31, 32). Invasive interventions such as surgery, radiofrequency ablation, surgical, root injections, epidural injections, are not recommended unless patients have neck pain associated with structural disruption or radiculopathy (20, 22, 33). More novel approaches, such as neurotomy and spinal cord stimulation have been proven to be effective in similar syndromes and may provide relief for neck pain as well (34-40).

The majority of patients with neck pain will recover with conservative treatment despite the many etiologies of neck pain (7). As noted above conservative treatment can provide short term relief to recovery. Regardless many invasive techniques such as radiofrequency ablation and intra-articular steroid injections are quite common for chronic neck pain that is refractory to conservative treatment. However, there are no studies that demonstrate their efficacy. Medial branch block is primarily a diagnostic technique but did demonstrate significant pain relief with repeated injections regardless of whether steroids were included with the local injection (11, 22). In the absence of serious pathology, no surgical technique has scientific support. The majority of patient remain significantly impaired post-surgery (7, 33). In patient with serious pathology surgery seems superior to non-invasive treatments only in the short term (3, 7).

3. Acupuncture

Acupuncture is part of traditional Chinese medicine where eliciting pain in one distinct area of the body is found to relieve pain and symptoms in another distinct area of the body (41). Acupuncture is thought to have originated in the fifth century and is a major component of the history of Chinese medicine that has been practiced for over 3,000 years (42, 43). In terms of performing the procedure, an acupuncture procedure is performed by placing a number of needles, between 5 and 20, in various defined areas of the body for a period of time (44). The needles can stay in the skin for as long as 20 minutes, and they may be manipulated by the practitioner during the procedure to produce the sensation they are seeking (44). Depending on the symptoms being treated, the initial treatment visit can last up to one hour, and subsequent visits can last half an hour and be as frequent as twice per week (44). A certified acupuncture practitioner will determine the amount of needles, placement of the needles, and frequency of the visits in order to best suit the condition being treated (44). Historically, it is believed that acupuncture was brought to Europe and America during the 18th century and thereafter it has been researched and attempted to be implicated in clinical practice (42). The theory is that acupuncture originated when early human civilization would place warm stones on areas of the body to relieve pain and symptoms they were experiencing (43). Throughout the evolution of acupuncture, pain was relieved by causing pain in another area by evolution methods of stones, bones, bamboo, iron, silver, gold, and now currently stainless steel in the acupuncture that we think of today (41). After acupuncture was introduced to places outside of China and started to gain popularity, many studies have been conducted to determine if there is a benefit in the use of acupuncture in things such as urinary tract infections, neuropathic pain, peripheral neuropathy, hip osteoarthritis, cerebellum balancing, allergic rhinitis, treatment of hypolactation, depression, gynecological conditions, migraine, chronic prostatitis, and post stroke spastic hemiplegia (2, 45-56).

Upon investigation of the specific mechanism of acupuncture, it was determined that traditional Chinese culture proposes that the mechanism of action of acupuncture is centered around the theory that the body has meridians, which are channels connecting each body part to each other, and collaterals, that interconnect the channels between each other (41). The theory is that blood and qi are being transported through these meridians and channels and this transportation must be equal to regulate and keep the body working properly (41). Qi is defined as an energy that is vital in promoting regulation of every function of the body and the goal is to have qi energy flow-

ing at the right amount, without any obstructions or blockages of the flow (41). When qi energy is not flowing equally, either in excess or lacking, or is found to be blocked, this is when symptoms and pain begin to develop (41). It is through these defined channels and collaterals that distinct acupuncture needle locations have been defined to help reduce pain in a certain body part, to provide the most benefit in equalizing the qi energy when being punctured (41). Aside from the traditional theory of the mechanism, studies have been performed to determine the mechanism of pain relief and one study concluded that the pain relief was not from the qi energy theory, but it was from neuroelectric stimulation causing neuropeptide gene expression (57). Other studies have shown that when the acupuncture needle penetrates afferent nerves, this may cause the release of opioids endogenously that improve pain (58). In addition, studies conducted using functional MRI have concluded that acupuncture effects are linked to specific regions of the brain and their placement impacts important brain structures and function (59). Different methods for acupuncture have been tested; clinical trials have shown efficacy in many fields, including chronic back pain, headache, and recovery time from general anesthesia (56, 60-64).

Once acupuncture is put into practice to achieve the desired mechanism, other things to consider are side effects from the procedure. In a study that investigated retrospective studies, case reports, and surveys of medical providers, they concluded the following to be the most common adverse effects of acupuncture: bruising, needle site bleeding, diarrhea, increased pain, nausea, vomiting, fainting, psychiatric disturbances, headaches, sweating, dizziness, and aggravation of symptoms (65). The same study compiled a list of rare complications which include: pneumothorax, spinal cord injury, hepatitis B, septicemia, injured organs, convulsions, and argyria (65). More specifically, a systemic review on acupuncture safety that looked at nine different studies found that the most common side effects were: needle pain, tiredness, and bleeding (65). Contraindications to acupuncture are in patients with automatic implantable cardioverter defibrillator and in patients who have a history of psychosis or delusions (2). In addition, it is reported that patients who are pregnant or receiving anticoagulation therapy are not completely contraindicated from acupuncture treatment, but they can be at risk for complications (2). Furthermore, in a study investigating the safety of acupuncture use in the pediatric population, they concluded that there is a 1.55 risk of adverse events in 100 acupuncture treatments, which demonstrated that there is a low risk for adverse events in pediatrics (66). Because acupuncture is a procedure that can produce potentially adverse side effects, the FDA has a close regulation on the needles used to perform acupuncture to ensure the safety and sterility of the procedure. The acupuncture needles are currently listed under class II medical devices with the FDA and are grouped in the category of complementary and alternative medicine items (67).

4. Acupuncture and Needling for Neck Pain

4.1. Dry Cupping Studies

A randomized controlled trial (RCT) pilot study (NCT01289964) investigated dry cupping as a treatment for chronic neck pain (68). Fifty patients aged 18 - 75 with chronic non-specific neck pain were randomized to receive treatment versus "wait list". Pain at rest (PR), pain related to movement (PM), neck disability index (NDI), and quality of life (SF-36) were assessed. The study also included sensory tests: Vibration-detection threshold (VDT), mechanical-detection threshold (MDT), and pressure-pain threshold (PPT). The treatment group received five dry cupping treatments over a two-week period, with no treatment in the control group. Common side effects were short-lived and self-terminated, including pain in tingling in treated areas and upper limbs, headache, and tiredness. One participant discontinued the treatment due to temporarily worsened symptoms. The treatment group reported significantly less pain after dry cupping treatment than the waiting-list group (PR: Δ-22.5 mm, P = 0.00002; PM: Δ-17.8 mm, p = 0.01). Analysis of the pain diaries (PD) demonstrated a gradual decrease in neck pain for the treatment group. The pain diaries also showed that after the fifth session, there was a significant difference in pain between the treatment and waiting-list group (Δ-1.1, P = 0.001). The SF-36 subscales for bodily pain (Δ13.8, P = 0.006) and vitality (Δ10.2, P = 0.006) demonstrated significant differences. There were significant differences between the two groups regarding PPT at pain-related and control areas (all $P < 0.05$), but not for MDT or VDT. The study concluded that five dry cupping treatment sessions appeared efficacious in alleviating chronic non-specific neck pain. A significant decrease in mechanical pain sensitivity in the treatment group suggests changed functional pain processing (68).

Another RCT analyzed cupping in chronic neck and shoulder pain (NSP) and measured changes in skin surface temperature (SST) (69). This study randomized 62 participants into a cupping or control group. The cupping group received five cupping therapies at three acupuncture points in the neck/shoulder areas, SI 15, GB 21, and LI 15, for 10 minutes on each side of the body. The control group rested for 20 minutes. SST was measured at 5-minutes interval in the treated points, and blood pressure (BP) was

measured before and after intervention. Pain was scored using a visual analog scale (VAS), and a Likert scale measured the subjective experience of pain intensity. The study found a significant increase in SST of about 2°C in the treatment group, as well as a significant decrease in BP (from 117.7 ± 2.9 mmHg to 111.8 ± 2.3 mmHg), however, there was no significant change in BP from the control group. Pain was significantly reduced in the treatment group, with average VAS decrease of 6.1 points (versus only 0.2 in the control group) for neck pain and 5.9 (versus 0.6 in controls) for shoulder pain (69).

ChiCTR800014723, an RTC, examined the effectiveness of ischemic compression therapy, dry cupping, and the combination of the two therapies in treating trigger points (TPs) associated with neck pain. The study randomized 24 patients to either treatment, or both and measured PPT, neck ROM and NDI pre-treatment and at four weeks post-treatment. All three groups demonstrated significant improvement in NDI, PPT, and neck ROM in comparison to the pre-treatment results. The study did not find a major difference between ischemic compression and dry cupping. The combination of the two treatment methods demonstrated more rapid and greater improvement (70).

A review by Trofa et al. (71) reviewed the above mentioned works and others. Though relatively safe, some studies reported adverse events of post-inflammatory hyperpigmentation, anemia requiring transfusion, formation of abscess, keloids, burns, blisters, body ache, skin laceration, itching, and pain at the site of cupping (71).

4.2. Dry Needling Studies

A prospective, nonrandomized study investigated the pain-reducing effects of dry needling on myofascial trigger points (MTrP). Participants experienced shoulder or neck pain for more than three months and had active myofascial trigger points. Each participant received three dry needling treatment sessions weekly. The study's primary outcome measurements included pain evaluations taken at baseline and after treatment using the VAS, the Brief Pain Inventory, and the status of the myofascial trigger point rated as either active, latent, or resolved. Of 52 participants, 41 experienced a trigger point status change from active to latent or resolved, and 11 reported no change. The reduction in all pain scores was significant ($P < 0.001$). Secondary outcome measurements involved a profile of mood states, Oswestry disability index (ODI), short form 36 (SF36) scores, and cervical ROM. PPT did not significantly change in either unilateral or bilateral MTrPs; physical functioning subscale scores increased significantly, as well as ODI scores, but not VAS scores. There was also improvement in cervical ROM. The study concluded that dry needling significantly reduced pain and changed trigger point status. The reduced pain was associated with an improvement in function, disability, and mood (72).

A randomized, single-blinded clinical trial (IS-RCTN22726482) examined the effectiveness of deep dry needling (DDN) of MTrPs as a treatment for chronic non-specific neck pain (NSNP). 128 subjects with NSNP and active MTrPs in cervical muscles were randomized to either the DDN group (DDN-plus passive stretching) or the control group (only passive stretching). Each group was provided with four treatments over two weeks and followed up six months later. Some participants experienced soreness and localized bleeding at the site of needle insertion lasting ≤ 1 week. Significant reductions in PPT, Pain intensity, ROM, strength and perceived disability (73).

A RCT (NCT02301468) examined the short- and long-term treatment effects of dry needling (DN) and manual pressure (MP) for myofascial pain in women. 42 female patients were randomized to receive four treatments of either DN or MP. One participant in the MP group and three in the DN group dropped out. Some soreness after dry needling treatment was reported. The study did not find significant differences between the two groups in PPT, muscle characteristics pre-and post-treatment, the neck disability index (NDI), and pain numeric rating scale (NRS). However, three months post-treatment, both groups experienced significant improvement in NDI and NRS, as well as PPT, muscle elasticity and stiffness (74).

4.3. Acupuncture Studies

A systematic review of 265 RCTs and 5 non-RCTs regarding complementary and alternative medicine (CAM) therapies analyzed the efficacy, harm, and cost-effectiveness of acupuncture, massage, spinal manipulation, and mobilization treating pain of the back, neck, and/or thoracic region. The most common adverse events associated with acupuncture included minor bleeding, bruising, soreness, pain at the needling site, lightheadedness, dizziness, and headache. The percentage of participants having had an adverse event was no different than conventional care or TENS groups. In treating chronic non-specific low back pain, acupuncture significantly reduced pain intensity compared to placebo, but only right after treatment. (VAS: -0.59, 95 percent CI: -0.93, -0.25). The review did not find a difference between acupuncture and placebo regarding intake of pain medication, overall improvement in chronic non-specific low back pain, or post-treatment disability. Regarding decreasing chronic non-specific neck pain immediately post-treatment, acupuncture and sham-acupuncture did not differ (VAS: 0.24, 95 percent CI: -1.20, 0.73). Compared to no treatment, acupuncture improved pain intensity (VAS: -1.19, 95 percent CI: 95 percent CI: -2.17, -0.21), disability (pain disability index; PDI), functioning

(Hannover Functional Ability questionnaire-HFAQ), well-being (SF-36), and range of mobility (extension, flexion), immediately post-treatment. Overall, the studies that involved sham-acupuncture more likely had statistically insignificant results versus studies that involved placebos such as laser therapy or medications. Studies produced less consistent results when compared to other treatments such as mobilization. When compared to conventional treatment or no treatment, acupuncture was more economical for treating chronic back pain (75).

A systematic review and meta-analysis examined fourteen RCTs of acupuncture for neck pain. The review included nine meta-analyses, seven of which demonstrated positive. The meta-analysis of short-term pain reduction (continuous data), the primary outcome, showed acupuncture more effective in treating neck pain compared to the control. The analysis also showed that acupuncture was better for pain relief than sham acupuncture. Other positive findings included improvement in neck ROM, cervical radiculopathy, and pain control (both versus sham or no treatment) (76).

This article outlines the design and rationale of a randomized, double-blind, controlled trial (code: ChiCTR-TRC-12002206) that intends to examine the safety and efficacy of acupuncture compared to sham acupuncture in treating neck pain caused by cervical spondylosis. The study's design is to randomize 456 recruited participants into either active acupuncture or sham acupuncture group. Treatments will occur five times/week for a total of two weeks. The Northwick Park Neck Pain questionnaire (NPQ) scale, short-form 36 (SF-36) scale, and McGill pain scale, demographics, adverse events, and neck physiological function will be assessed at baseline and intervention for both weeks. Follow-ups will occur at four, eight, and twelve weeks post-intervention. This article was published in 2013, and the study's published outcome is not available per the Chinese Clinical Trial Registry (77).

A study examined acupuncture efficacy with seven acupoint-penetrating needles on sixty patients with cervical spondylosis. The patients were randomized into either group A, which received acupuncture with seven acupoint-penetrating needles plus traction or group B, which received acupuncture of non-relevant acupuncture points plus traction. The study compared the two groups based on efficacy and score changes for the Visual Analogue scale (VAS), neck disability index (NDI), and the Pittsburgh sleep quality index (PSQI). Group A demonstrated a significantly higher total effective rate (90.0%) compared to group B (76.6%) ($P < 0.05$). The post-treatment scores for VAS, NDI, and PSQI were significantly lower for both groups than the pre-treatment scores ($P < 0.05$). Group A demonstrated significantly lower NDI and PSQI scores post-treatment than group B ($P < 0.05$). The study's findings concluded that in patients with cervical spondylosis, acupuncture with seven acupoint-penetrating needles plus traction had greater efficacy, pain reduction, and better quality of sleep versus acupuncture of non-relevant acupuncture points (78).

A study analyzed fast acupuncture versus retaining acupuncture in the treatment of the cervical type of cervical spondylosis. The study randomized 60 participants into either the fast acupuncture group or the retaining needle group. For the fast acupuncture group, the needles were removed after the arrival of qi. For the retaining needle group, the needles remained in place for 30 minutes. The study used the NPQ and short-form McGill pain questionnaire (SF-MPQ) [pain rating index (PRI), Visual Analogue scale (VAS), and present pain intensity (PPI)] to measure outcomes before and after treatment. For both groups, the NPQ score decreased after treatment (both $P < 0.01$), and the fast acupuncture group had greater improvement ($P < 0.01$). For both groups, all components of the SF-MPQ were lower compared to the pre-treatment scores (all $P < 0.01$). The fast acupuncture group had better PRI sensation and PRI total score (both $P < 0.05$). Post-treatment, the PRI feeling score, VAS score, and PPI scores were not significantly different between the two groups (all $P > 0.05$). With the fast acupuncture group's total effective rate being 83.3% (25/30), there was not a significant difference from the 76.7% (23/30) of the retaining needle group ($P > 0.05$). The study concluded that both fast and retaining needle acupuncture were efficacious in improving the cervical type of cervical spondylosis symptoms. The study found fast acupuncture to be better than retaining needle acupuncture [This article was originally written in Chinese; only the abstract was available in English] (79).

A randomized controlled trial (code: ChiCTR-TRC-14004932) investigated the efficacy of abdominal acupuncture to treat neck pain. One hundred fifty-four neck pain patients were randomized to either receive abdominal acupuncture (group A) or non-penetrating sham abdominal acupuncture (group S) and received three treatments/week for two weeks. The Northwick Park Neck Pain questionnaire (NPQ) assessed the primary outcome, mean improvement in neck pain disability. Neck pain intensity and health-related quality-of-life measures were secondary outcome measurements. The study analyzed outcomes at baseline, two weeks, and six weeks after the baseline assessment. An additional follow-up meeting occurs after fourteen weeks from the baseline assessment for the participants who received abdominal acupuncture. In the abdominal acupuncture group, 11 participants developed bruises at the needle insertion site one time each. Neither group reported adverse side effects. The abdominal

acupuncture group demonstrated greater improvement compared to the sham acupuncture group in NPQ scores at two weeks (intergroup mean differences, -5.75; 95% confidence interval [CI], -9.48 to -2.03; P = 0.008) and at six weeks (intergroup mean difference, -8.65; 95% CI, -12.13 to -5.16; P < 0.001). At 14 weeks, the abdominal acupuncture group had significantly greater improvement in NPQ scores compared to baseline. The abdominal acupuncture group had significantly greater improvement than the sham acupuncture group regarding the intensity of neck pain and health-associated quality of life measurements. The findings of the study advocated for the efficacy of abdominal acupuncture in treating neck pain (80).

A randomized, blinded crossover study examined alterations in the myoelectric activity of the upper trapezius and non-specific neck pain after one acupuncture session. The study included fifteen subjects with neck pain (neck pain group, NPG) and fifteen healthy subjects (control group, HPG). Within each group, participants were randomized to either receive one session of acupuncture or sham acupuncture treatment. The acupuncture targeted acupoints of triple energizer 5 (TE-5) and large intestine 11 triple energizer 5 (LI-11 TE-5). The primary outcome was the result of electromyography (EMG) of the upper trapezius muscle. Before and following acupuncture treatment, the EMG signal was recorded during step contractions involving four shoulder elevation force levels (15%, 20%, 24%, and 30% maximum voluntary contraction). The study demonstrated significant decreases in amplitude of EMG after acupuncture treatment in both the neck pain group ($F_{1,112}$ = 26.82; P < 0.0001) and the control group ($F_{1,112}$ = 21.69; P < 0.0001). For the NPG, the Numeric Rating Scale score (NRS) ($F_{1,28}$ = 51.61; P < 0.0001) and pain area ($F_{1,2}$ = 32.03; P < 0.0001) demonstrated significant effects post-treatment for both acupuncture and sham. The study found no difference between acupuncture and sham acupuncture treatment for NRS score (NPG: $F_{1,28}$ = 0.95; P = 0.33), pain area (NPG: $F_{1,28}$ = 1.97; P = 0.17), or EMG amplitude (NPG: $F_{1,112}$ = 0.47; P = 0.49; HPG: $F_{1,112}$ = 0.75; P = 0.38). No adverse effects were reported after acupuncture treatment. The study concluded that acupuncture at TE-5 and LI-11 TE-5 acupoints, or close to these points, helped improve neck pain. For both the NPG and control group, EMG demonstrated decreased hyperactivity of the upper trapezius muscle and increased resistance to muscle fatigue (81).

A review analyzed 25 RCTs regarding noninvasive nonpharmacologic treatments for chronic neck pain. Combination exercise and low-level laser therapy both improved function and pain to a certain degree. Acupuncture provided some functional improvement but did not reduce pain when compared to sham acupuncture. The Alexander technique, a mind-body practice, also demonstrated some improvement in function. Massage did not improve function, and physical therapist-led relaxation techniques did not improve function or pain. All of the above received a strength of recommendation (SOR) of B due to inconsistent or limited-quality evidence that is patient-oriented. The review concluded that physicians should discuss these nonpharmacologic options with patients and consider including combination exercise, low-level laser therapy, acupuncture, and the Alexander technique to treat chronic neck pain (82).

A systemic review and meta-analysis of sixteen RCTs examined the safety and efficacy of acupuncture and electroacupuncture in treating chronic neck pain. The review included nine acupuncture studies and seven electroacupuncture studies. The studies included in the review had treatment groups with or without active control and control groups that received typical intervention options, medication or physical therapy. The review examined the results of disability, quality of life, intensity, and adverse effects. Of note, four trials included in the review had an independent evaluator carry out allocation concealment. Another trial used sealed envelopes. Therefore, the bias risk was considered low for these trials. The remaining eleven studies did not specify allocation concealment or evaluation of bias. There was not a significant difference in pain between the acupuncture group and the active control group (SMD 0.24, 95% CI: -0.27 - 0.75), disability (SMD 0.51, 95% CI: -0.01 - 1.02), or quality of life (SMD -0.37, 95% CI: -1.09 - 0.35). Acupuncture added into the control group demonstrated greater pain relief in the studies with unclear allocation concealment (SMD -1.78, 95% CI: -2.08 - - 1.48). However, when acupuncture was added into the control group in studies with good allocation concealment there was no significant pain relief (SMD - 0.07, 95% CI: - 0.26 - 0.12). The electroacupuncture versus the control or electroacupuncture plus the active control demonstrated significant pain relief. However, the findings had a low level of evidence. The review noted that no adverse events were reported. The review concluded that acupuncture and conventional therapy demonstrated similar effects regarding pain relief and disability. Pain relief was better when acupuncture was added onto conventional therapy, and electroacupuncture lessened pain to a greater degree. The review stated that additional studies are needed as forming a conclusion was challenging due to the risk of bias and unreliability of the studies (83).

A randomized clinical trial (code: IRCT20100127003217N12) investigated electroacupuncture and biofeedback along with conventional therapy in treating cervical myofascial pain syndrome (MPS). Fifty participants were recruited and randomized into two groups. The 25 participants in the electroacupuncture

group completed the study. Twenty-five participants in the biofeedback group started the study, but only 23 completed the study. Both groups received their respective interventions twice/week with six sessions in total. All participants received 7.5 mg of meloxicam once daily and taught exercises for shoulder and neck muscles. The study assessed VAS for the severity of pain, NDI, ROM, and PPT at pre-treatment, three weeks, and twelve weeks post-treatment. The study set the primary outcome, measured through NDI, as a 20% reduction in dysfunction and neck pain at three months compared to the baseline measurement. The electroacupuncture and biofeedback group demonstrated significant improvement in all parameters except for the PPT of the paravertebral muscles and lower trapezius. The acupuncture group reached the primary outcome to a greater extend compared to the biofeedback group: 20 (80.0%) vs 10 (40.0%); rate ratio = 2 with 95% CI, 1.19 - 3.36; number needed to treat (NNT) = 2.5 with 95% CI, 1.54 - 6.58. Acupuncture showed greater clinical benefit compared to biofeedback as per the values of NDI, VAS, extension and left lateral-bending ROM, and PPT on the left upper trapezius after the last treatment session until the 3-month follow-up ($P < 0.05$). The study found both electroacupuncture and biofeedback therapies coupled with medication and exercises to decrease pain, increase PPT and cervical ROM, and decrease functional disability in patients with myofascial neck pain. Intergroup differences demonstrated that for some parameters, electroacupuncture was better than biofeedback. The study concluded that electroacupuncture appeared to be superior in treating cervical MPS (84).

An RCT (KCT0002320) examined the safety and efficacy of thread-embedding acupuncture (TEA) using polydioxanone along with conventional care for patients with chronic non-specific neck pain (CNP) versus treatment with only conventional care. A total of 106 CNP participants were randomized to either the TEA plus usual care (TU) group or the usual care (UC) group. TEA treatments occurred once weekly for a total of four weeks. The study defined typical care for treating neck pain to include physical therapy, massage, spinal manipulation, and analgesics. Typical care was provided as needed for patients in both groups. The study's primary outcome measurement was the mean Neck Pain and Disability scale (NPDS) score. The study's secondary outcome measurements were pressure pain threshold (PPT), Hospital Anxiety and Depression scale (HADS), clinically important difference (CID), EuroQol-5 dimension (EQ-5D), and patient global impression of change (PGIC). Assessments occurred at baseline, 3, 5, and 9 weeks. In the TU group, 12 participants reported adverse events associated with TEA of neck stiffness, bruising, skin flare, pruritus, and irritation due to the thread. NPDS scores significantly improved in the TU group compared with the UC group (adjusted group difference, week 5: 13.74 [95% CI: 7.57 - 19.90]; $P < 0.0001$ and week 9: 17.46 [95% CI: 11.15 - 23.76]; $P < 0.0001$). For the TU group at weeks 5 and 9, the fraction of patients with a lower NPDS score of ‡11.5 points (minimal CID) was significantly higher than the UC group. For both groups at weeks 5 and 9, the study showed significant differences on the HADS, EQ-5D, and PGIC, but not for the PPTs at the three measured sites, the insertion area of the levator scapulae muscle, GB21 of the upper trapezius, and the space extending 1.5 cm out from the sixth cervical vertebra. The study's findings indicated TEA, along with conventional care, to be safe and effective in treating CNP (85).

A systemic review and meta-analysis (CRD42016042956) examined six RCTs regarding the efficacy of acupuncture in treating localized unremitting myofascial pain of the head and neck. The study's primary outcome measurement was the mean pain severity score (VAS) for acupuncture versus sham-needling or no intervention groups. No serious adverse events were reported. There was a decrease in VAS scores for acupuncture groups compared to sham needling/no intervention groups in all six studies. The meta-analysis included only four of the RCTs and showed acupuncture's pain intensity score 19.04 points less than sham-needling/no intervention's score (95% CI: -29.13 to -8.95). The findings propose that acupuncture may be safe and efficacious for decreasing unremitting myofascial pain of the head and neck. Additional studies with a more standardized design are needed to provide further compelling evidence (86).

Several RCTs are ongoing or in the recruitment phases, mostly in China. These focus more on head-to-head trials, that are missing from the landscape and would better allow to correctly choose the type of intervention for patients. ChiCTR-IOR-15006886 is a Chinese RCT that aims to investigate the effectiveness of acupuncture in treating chronic neck pain versus sham acupuncture. The study's design is to randomize 175 recruited patients into five separate groups: a traditional acupuncture group (group A), a shallow-puncture group (group B), a non-acupoint acupuncture group (group C), a non-acupoint shallow-puncture group (group D), and a sham-puncture group (group E) (87). Other planned trials will evaluate acupuncture for spondylosis (88), compare high and low sensitivity acupuncture to sham (89), and collect biometric data comparing healthy volunteers and participants with NSNP (90).

5. Conclusions

Chronic neck pain is neck pain lasting 3 - 6 months, pain that does not resolve after an acute phase. This can, unfortunately, happen in up to 85% of patients suffering from acute neck pain, as estimated by some studies, though more conservative numbers likely place this at 10% - 30%. This leads to extremely high prevalence, estimated as high as 288 million cases globally in 2017. Most commonly, neck pain is of musculoskeletal sources, and most risk factors are modifiable; though, these risk factors -such as office and computer work- continue to increase in prevalence. Neck pain often leads to depression, reduced satisfaction, and disability.

Traditional treatment for neck pain includes pharmacologic agents, such as NSAIDs, muscle relaxants and prescription analgesics. Mobilization and manipulation, physical exercise and therapy, as well as electric (TENS) and electromagnetic therapy. These conservative treatments are recommended when no anatomical pathology exists; if the latter does occur, more invasive methods, such as intra-articular injections, radiofrequency ablation, medial branch blocks and surgery may be indicated. These invasive methods carry increased risks that must be weighed in light of the specific pathology and patient choice.

Acupuncture involves inserting thin, firm needles into specific points in a patient body in hopes to clear blockages and allow free flow of a person's Qi. It has been used in traditional Chinese medicine for hundreds of years and recently explored through the eyes of Western Medicine in several different conditions of chronic pain and disability. Acupuncture has been expanded to include, beyond the traditional Chinese methods, other methods that include dry needling, heat acupuncture, acupressure and electropuncture. Dry cupping does not involve needling but is also similar in method otherwise. Though the actual method through which acupuncture alleviates pain is not clearly understood, studies show that it likely involved nerve stimulation via tactile skin stimulation leading to the release of neuromodulators into the plasma and CSF, which then lead to pain alleviation.

The above listed evidence shows a plethora of data, most of it supporting the use of acupuncture and other CAM in the treatment of neck pain. Indeed, Table 1 systematically summarizes the available evidence available for the use of acupuncture in chronic neck pain. Acupuncture was shown to have both immediate and long-lasting effect on pain, disability, and related symptoms. It is generally safe and inexpensive. Unfortunately, very few head-to-head trials exist, and it is hard to point at a certain intervention as superior to others.

Footnotes

Authors' Contribution: Study concept and design: AAB, YL, LM, MAC, MTR, EMC, ADK, and IU. Analysis and interpretation of data: AAB, YL, LM, MAC, and MTR. Drafting of the manuscript: AAB, YL, LM, MAC, MTR, EMC, ADK, FI, AS, GV, OV, and IU. Critical revision of the manuscript for important intellectual content: AAB, YL, LM, MAC, MTR, EMC, ADK, FI, AS, GV, OV, and IU. Statistical analysis: AAB, YL, LM, MAC, and MTR.

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Table 1. Clinical Efficacy and Safety

Author (Year)	Groups Studied and Intervention	Results and Findings	Conclusions
Lauche et al. (2011) (68)	(NCT01289964) Fifty patients, ages 18 to 75, with chronic non-specific neck were randomized into a treatment or waitlist group. Assessments included pain at rest (PR), pain related to movement (PM), neck disability index (NDI), and quality of life (SF-36). Sensory tests included vibration-detection threshold (VDT), mechanical-detection threshold (MDT), and pressure-pain threshold (PPT). The treatment group received five dry cupping treatments over a two week period, in contrast to the waiting-list group who received no treatment. Participants again completed questionnaires and underwent sensory testing a second time 18 days after baseline assessment. The study offered the waiting-list group cupping treatment upon completion the post-intervention assessment.	The treatment group reported significantly less pain after dry cupping treatment than the waiting-list group (PR: Δ-22.5 mm, P = 0.00002; PM: Δ-17.8 mm, P = 0.01). Analysis of the pain diaries (PD) demonstrated a gradual decrease in neck pain for the treatment group and after the fifth session, there was significant difference in pain between the treatment and waiting-list group (Δ-1.1, P = 0.001). The SF-36 subscales for bodily pain (Δ13.8, p = 0.006) and vitality (Δ10.2, P = 0.006) demonstrated significant differences. There were significant differences between the two groups regarding PPT at pain-related and control areas (all $P < 0.05$), but not for MDT or VDT.	Five dry cupping sessions were efficacious, safe, and generally well tolerated in treating chronic non-specific neck pain. Additionally, there was a significant difference in mechanical pain sensitivity between the two groups, which indicated that cupping has a role in functional pain processing.
Chi et al. (2016) (69)	A RCT analyzed cupping therapy's effectiveness for chronic neck and shoulder pain (NSP) and measured changes in skin surface temperature (SST). The study recruited sixty-two participants and excluded two cases due to analgesic consumption before the study. The study randomized participants into a cupping or control group.	The ANCOVA test demonstrated significant differences between the groups at each time point for GB 21, SI 15, and LI 15 acupuncture points ($P < 0.05$). In the cupping group, the VAS of neck pain intensity (NPI) was 9.7 $\pm$ 1.6 at baseline; posttreatment NPI decreased by 6.1. In the control group, the VAS of NPI was 9.7 $\pm$1.6 at baseline; posttreatment NPI decreased by 0.2. The ANCOVA test showed significant differences between the two groups ($P < 0.001$). In the cupping group, the VAS of shoulder pain intensity (SPI) was 8.5 $\pm$ 0.9 at baseline; posttreatment SPI decreased by 5.9. For the control group, the VAS of SPI was 8.5 $\pm$ 0.9; posttreatment SPI decreased by 0.6. The difference was statistically significant ($P < 0.001$) between the two groups.	After one treatment session, SST increased and SBP decreased. Dry cupping therapy is considered a safe and effective treatment for chronic neck and shoulder pain.
Trofa et al. (2020) (71)	A review analyzed publications on cupping and blood flow restriction as non-surgical treatment modalities for musculoskeletal conditions.	Due to the low risks associated with dry cupping therapy and present data, physicians can suggest this cupping therapy to those athletes with neck, shoulder, or back pain who are interested. Studies suggest that low-load BFR training can improve muscle strength, endurance, and possibly improve injury recovery.	The review concluded that additional studies are needed to further evaluate these non-surgical modalities of treatment.
Gerber et al. (2015) (72)	A nonrandomized, controlled, clinical study investigated the pain reducing effects of dry needling on a myofascial trigger point (MTrP). 52 participants completed the study and each participant received three weekly dry needling treatment sessions.	Primary outcome: 41 subjects experienced a trigger point status change from active to latent or resolved, and 11 subjects reported no change ($P < 0.001$). Reduction in all pain scores was significant ($P < 0.001$). Secondary outcomes: pain pressure threshold in participants with unilateral MTrPs (P = 0.006) and bilateral MTrPs (P = 0.012); improvement in the SF-36 mental health (P = 0.019) and physical functioning subscale scores (P = 0.03); and a decrease in the Oswestry Disability Index score (P = 0.003) improvement in posttreatment cervical range of motion in participants with unilateral (P = 0.001) and bilateral MTrPs (and P = 21).	Dry needling significantly reduced pain and changed trigger point status. The reduced pain was associated with an improvement in function, disability, and mood.

Cerezo-Tellez et al. (2016) (73)	(ISRCTN22726482) The study examined the effectiveness of deep dry needling (DDN) of MTrPs as a treatment for chronic nonspecific neck pain. One hundred and twenty eight participants completed all assessments of the study, out of the recruited 130. Participants were randomized to either the DDN group (DDN-plus passive stretching) or control group (only passive stretching). The program for both groups occurred for two weeks with treatment sessions twice/week; 4 treatment sessions in total and a six-month follow-up meeting.	Pain intensity was the primary outcome measurement. Pressure pain threshold, active ROM of the neck, neck strength, and perceived disability associated with the neck were secondary outcome measurements. The study found clinically important and significant differences regarding dry needling as a treatment in all the measured outcomes (all $P < 0.001$).	DDN and passive stretching are more effective compared to only passive stretching in treating nonspecific neck pain. DDN is an effective treatment of myofascial pain syndrome in the setting of chronic nonspecific neck pain.
De Meulemeester et al. (2017) (74)	(NCT02301468) The study included 42 females who were randomized to either a DN (20 subjects) or MP (22 subjects) group and received a total of four treatment sessions. During the study, 1 from the MP group and 3 from the DN group stopped participating.	Primary outcome measurements: pressure pain threshold, muscle characteristics pre-and post-treatment, the neck disability index, and general numeric rating scale. The study did not find significant differences between the two groups. The neck disability index improved for both groups after 4 treatments and 3 months ($P < 0.001$); after 3 months, the general numerical rating scale significantly decreased. Pain pressure threshold, muscle elasticity, and stiffness showed significant improvement.	The findings of the study showed that both DN and MP had short- and long-term effects. Dry needling was no more effective in treating myofascial neck/shoulder pain when compared to manual pressure.
Fu et al. (2009) (76)	A systematic review and meta-analysis examined fourteen randomized controlled trials of acupuncture for neck pain.	Seven of nine meta-analyses showed positive results that acupuncture was significantly better than the control ($P < 0.05$). The meta-analysis of short-term pain reduction showed acupuncture more effective in treating neck pain compared to the control (standardized mean difference of -0.45 (95% confidence interval [CI], -0.69 to -0.22)). The meta-analysis also showed that acupuncture was better for pain relief than sham acupuncture (standardized mean difference of -0.53 (95% CI, -0.94 to -0.11)). The two negative meta-analyses noted no significant difference regarding improving disability in patients with neck pain between acupuncture vs. sham TENS; and the difference between acupuncture vs. sham TENS in long-term pain relief for neck pain was not statistically significant	The findings of the meta-analysis showed acupuncture to be effective in treating neck pain. The review stated that additional studies are needed to further investigate the acupuncture's effectiveness long-term and improvement in disability
Que et al. (2013) (77)	(ChiCTR-TRC-12002206) This article outlines the design and rationale of a randomized, double-blind, controlled trial that intends to examine the safety and efficacy of acupuncture compared to sham acupuncture in the treatment of neck pain caused by cervical spondylosis.	The study's design is to randomize 456 recruited participants into either an active acupuncture or sham acupuncture group. Treatments will occur five times/week for a total of two weeks. The Northwick Park Neck Pain questionnaire (NPQ) scale, short-form 36 (SF-36) scale, and McGill pain scale, demographics, adverse events, and neck physiological function will be assessed at baseline and intervention for both weeks. Follow-ups will occur at 4, 8, and 12 weeks post-intervention.	
Zuo et al. (2019) (91)	(CRD42019119941) This article outlines the design and rationale of a systemic review and meta-analysis that aims to assess the safety and effectiveness of acupuncture and chiropractic for treating cervical spondylosis radiculopathy (CSR).		This article was published in 2019; and the review status is ongoing per PROSPERO.

Gu et al. (2019) (78)	A study examined acupuncture efficacy with seven acupoint-penetrating needles on sixty patients with cervical spondylosis. The patients were randomized into either group A, which received acupuncture with seven acupoint-penetrating needles plus traction or group B, which received acupuncture of non-relevant acupuncture points plus traction.	The two groups were compared on the basis of efficacy and score changes for the VAS, neck disability index (NDI), and Pittsburgh sleep quality index (PSQI). Group A demonstrated a significantly higher total effective rate (90.0%) compared to group B (76.6%) ($P < 0.05$). The post-treatment scores for VAS, NDI, and PSQI were significantly lower for both groups than the pre-treatment scores ($P < 0.05$). Group A demonstrated significantly lower NDI and PSQI scores post-treatment than group B ($P < 0.05$).	The study concluded that in patients with cervical spondylosis, acupuncture with seven acupoint-penetrating needles plus traction had greater efficacy, pain reduction, and better quality of sleep versus acupuncture of non-relevant acupuncture points.
Yang et al. (2017) (87)	(ChiCTR-IOR-15006886) This article outlines the rationale and design of a five-arm, randomized, controlled trial that aims to investigate the effectiveness of acupuncture in treating chronic neck pain versus sham acupuncture.	The study's design is to randomize 175 recruited patients into five separate groups: A traditional acupuncture group, a shallow-puncture group, a non-acupoint acupuncture group, a non-acupoint shallow-puncture group, and a sham-puncture group. Treatments will occur twice/week for a total of five weeks with each session lasting twenty minutes. The Northwick Park Neck Pain questionnaire (NPQ) will be used to assess the primary outcome. The pain threshold, the short form McGill Pain questionnaire-2 (SF-MPQ-2), the 36-Item Short-Form Health survey (SF-36) and diary entries will be used to assess secondary outcomes. Data analysis will occur at baseline, after the treatment intervention, and at the 3 month follow-up meeting; the study will evaluate acupuncture safety at the end of each treatment period.	The trial was designed to be completed by December 31, 2017.
Ho et al. (2017) (80)	(ChiCTR-TRC-14004932) An RCT investigated the efficacy of abdominal acupuncture for the treatment of neck pain. One hundred and fifty four neck pain patients were randomized to either receive abdominal acupuncture (group A) or non-penetrating sham abdominal acupuncture (group S) and received three treatments/week for two weeks.	Group A demonstrated greater improvement vs. Group S in NPQ scores at two weeks (intergroup mean differences, -5.75; 95% confidence interval [CI], -9.48 to -2.03; $P = 0.008$) and at six weeks (intergroup mean difference, -8.65; 95% CI, -12.13 to -5.16; $P < 0.001$). At 14 weeks, group A had significantly greater improvement in NPQ scores compared to baseline. Group A had significantly greater improvement compared to group S regarding the intensity of neck pain and health-associated quality of life measurements.	The study concluded that abdominal acupuncture was efficacious in treating neck pain.
Calamita et al. (2018) (81)	A randomized blinded crossover study examined alterations in the myoelectric activity of the upper trapezius and non-specific neck pain after one acupuncture session. The study included fifteen subjects with neck pain (NPG) and fifteen subjects who were healthy (control group; HPG). Within each group, participants were randomized to either receive one session of acupuncture or sham acupuncture treatment. The acupuncture targeted acupoints of triple energizer 5 (TE-5) and large intestine 11 triple energizer 5 (LI-11 TE-5).	The study demonstrated significant decreases in amplitude of EMG after acupuncture treatment in both the NPG ($F_{1,112} = 26.82$; $P < .0001$) and the control group ($F_{1,112} = 21.69$; $P < .0001$). For the NPG, the Numeric Rating Scale score (NRS) ($F_{1,28} = 51.61$; $P < 0.0001$) and pain area ($F_{1,2} = 32.03$; $P < 0.0001$) demonstrated significant effects post-treatment for both acupuncture and sham. The study found no difference between acupuncture and sham acupuncture treatment for NRS score (NPG: $F_{1,28} = 0.95$; $P = .33$), pain area (NPG: $F_{1,28} = 1.97$; $P = 0.17$), or EMG amplitude (NPG: $F_{1,112} = 0.47$; $P = 0.49$; HPG: $F_{1,112} = 0.75$; $P = 0.38$).	The study concluded that acupuncture at TE-5 and LI-11 TE-5 acupoints, or close to these points, helped improve neck pain. For both the NPG and control group, EMG demonstrated decreased hyperactivity of the upper trapezius muscle and increased resistance to muscle. The study noted that further studies are necessary.

Barreto and Svec (2019) (82)	A review analyzed 25 RCTs regarding noninvasive nonpharmacologic treatments for chronic neck pain.	Combination exercise and low-level laser therapy both improved function and pain to a certain degree. Acupuncture provided some functional improvement but did not reduce pain when compared to sham acupuncture. The Alexander technique, a mind- body practice, also demonstrated some improvement in function. Massage did not improve function, and physical therapist-led relaxation techniques did not improve function or pain. All received a strength of recommendation (SOR) of B due to inconsistent or limited-quality evidence that is patient-oriented.	The review concluded that physicians should discuss these nonpharmacologic options with patients, and should consider including combination exercise, low-level laser therapy, acupuncture, and/or the Alexander technique as treatments of chronic neck pain.
Sun et al. (2019) (89)	(ChiCTR1800016371) This article outlines the design and rationale of a randomized, controlled trial that intends to examine the safety and efficacy of needling at specific acupoints as a treatment of chronic neck pain. A total of 716 participants will be recruited and randomized into four groups: the highly sensitive acupoints group, low/non-sensitive acupoints group, sham acupuncture group, and the waiting-list control group.		The study was expected to end in December 2019.
Sun et al. (2019) (90)	(ChiCTR1800016220) This article outlines the design and rationale of a case-control study that intends to analyze sensitization types and the distribution of sensitized points in neck pain patients. A total of 224 patients with neck pain and 224 healthy subjects (control) will be recruited. Measurements of pressure pain threshold, skin resistance, body surface temperature, and mechanical pain threshold will be taken at the fifteen most common acupoints associated with treating neck pain. These measurements will also be taken at the five body areas in which pain is most often experienced.		The results of the study will provide information regarding choosing the best acupuncture points for treating neck pain.
Eslamian et al. (2020) (84)	(IRCT20100127003217N12) A randomized clinical trial investigated electroacupuncture and biofeedback along with conventional therapy in treating cervical myofascial pain syndrome (MPS). Fifty participants were recruited and randomized into either electroacupuncture or biofeedback group. The study set the primary outcome, measured through NDI, as a 20% reduction in dysfunction and neck pain at three months in comparison to the baseline measurement.	The study analyzed fifty patients (39 women, 11 men) with characteristics of a mean age $\pm$ SD of 39.0 $\pm$ 5.5 year and neck pain of 6.0 $\pm$ 2.2 weeks. Electroacupuncture and biofeedback group demonstrated significant improvement in all parameters except for the PPT of the paravertebral muscles and lower trapezius. The acupuncture group reached the primary outcome to a greater extend compared to the biofeedback group: 20 (80.0%) vs 10 (40.0%); rate ratio = 2 with 95% CI, 1.19 - 3.36; number needed to treat (NNT) = 2.5 with 95% CI, 1.54 - 6.58. Acupuncture showed greater clinical benefit compared to biofeedback as per the values of NDI, VAS, extension and left lateral-bending ROM, and PPT on the left upper trapezius after the last treatment session until the 3 month follow-up ($P < 0.05$).	The study found both electroacupuncture and biofeedback therapies coupled with medication and exercises to be efficacious for myofascial neck pain. Intergroup differences demonstrated that for some parameters electroacupuncture was better than biofeedback. The study concluded that electroacupuncture appeared to be superior in treating cervical MPS.
Farag et al. (2020) (86)	(CRD42016042956) A systemic review and meta-analysis examined six RCTs regarding the efficacy of acupuncture in treating localized unremitting myofascial pain of the head and neck. The study's main outcome measurement was the mean pain severity score (VAS) for acupuncture versus sham-needling or no intervention groups.	There was a decrease in VAS scores for acupuncture groups compared to sham needling or no intervention groups in all six studies. The meta-analysis included only four of the RCTs and showed acupuncture's pain intensity score 19.04 points less than sham-needling/no intervention's score (95% CI: -29.13 to -8.95).	The findings propose that acupuncture may be safe and efficacious for decreasing unremitting myofascial pain of the head and neck. Additional studies with a more standardized design are needed in order to provide further compelling evidence.

Kim et al. (2019) (85)	(KCT0002320) An RCT examined the safety and efficacy of thread-embedding acupuncture (TEA) using polydioxanone along with conventional care for patients with chronic nonspecific neck pain (CNP) versus treatment with only conventional care. A total of 106 CNP participants were randomized to either the TEA plus usual care (TU) group or the usual care (UC) group.	NPDS scores significantly improved in the TU group compared with the UC group (adjusted group difference, week 5: 13.74 [95% confidence interval: 7.57 - 19.90]; $p < 0.0001$ and week 9: 17.46 [11.15 - 23.76]; $p < 0.0001$). For the TU group at weeks 5 and 9, the fraction of patients with a lower NPDS score of ‡11.5 points (minimal CID) was significantly higher compared to the UC group. For both groups at weeks 5 and 9, the study showed significant differences on the HADS, EQ-5D, and PGIC, but not for the PPTs at the three measured sites.	The findings of the study indicated TEA, along with conventional care, to be safe and effective in treating CNP.
Pan et al. (2018) (92)	A systemic review and meta-analysis analyzed thirty-five studies regarding acupuncture as a clinical treatment for osteoporosis. The RCTs compared warm acupuncture, needling or electroacupuncture to Western medicine in treating osteoporosis.	Compared with Western medicine, warm acupuncture increased the level of serum calcium (MD = 0.18, 95% CI = 0.13, 0.24, P < 0.00001) and estradiol (SMD = 0.65, 95% CI = 0.32, 0.98, P = 0.0001), the bone mineral density of lumar* (SMD = 0.93, 95% CI = 0.65, 1.21, P < 0.00001) and femur (MD = 0.11, 95% CI = 0.05, 0.16, P = 0.0002), relieved pain (MD = =1.64, 95% CI = -2.69, -0.59, P = 0.002), and decreased the level of serum alkaline phosphatase (MD = -7.8, 95% CI = -14.17, -0.84, P = 0.03). Compared with Western medicine, electroacupuncture increased the level of serum calcium (MD = -0.12, 95% CI = -0.16, -0.09, P < 0.00001), relieve pain (MD = -1.32, 95% CI = -2.15, -0.48, P = 0.002), and decreased the level of serum alkaline phosphatase (MD = -3.63, 95% CI = -6.60, -0.66, P = 0.02). The review found, in comparison with Western medicine, needling relieved pain (MD = -2.27, 95% CI = -3.11, -1.43, P < 0.00001).	The review found acupuncture to be efficacious in treating osteoporosis. Warm acupuncture appeared to be superior compared to electroacupuncture and needling in treating osteoporosis in comparison to Western medicine. The study concluded that additional clinical trials are needed.
Seo et al. (2017) (83)	A systemic review and meta-analysis of 16 RCTs examined the safety and efficacy of acupuncture and electroacupuncture in treating chronic neck pain. The review included 9 acupuncture studies and 7 electroacupuncture studies. The studies included in the review had treatment groups with or without active control, and control groups that received typical intervention options, medication or physical therapy.	There was not a significant difference in pain between the acupuncture group and the active control group (SMD 0.24, 95% CI -0.27 - 0.75), disability (SMD 0.51, 95% CI -0.01 - 1.02), or quality of life (SMD -0.37, 95% CI -1.09 - 0.35). Acupuncture added into the control group demonstrated greater pain relief in the studies with unclear allocation concealment (SMD -1.78, 95% CI -2.08 - - 1.48). However, when acupuncture was added into the control group in studies with good allocation concealment there was not significant pain relief (SMD - 0.07, 95% CI -0.26 - 0.12). The electroacupuncture vs. the control or electroacupuncture plus the active control demonstrated significant pain relief, however, the findings had a low level of evidence.	Acupuncture and conventional therapy demonstrated similar effects for pain relief and disability. Pain relief was better when acupuncture was added onto conventional therapy, and electroacupuncture lessened pain to a greater degree. Additional studies are needed as forming a conclusion was challenging due to the risk of bias and unreliability of the studies.
Chen et al. (2019) (93)	(Only abstract available for review in English) A literature analysis examined the quality of randomized controlled trails for acupuncture as a treatment of chronic neck pain per the (CONSORT) and (STRICTA). The analysis examined both English and Chinese articles that were published between the dates of January 2008 to January 2018. The analysis included a total of 29 Chinese articles and 10 English articles.	The analysis found that Chinese literature is better at included acupuncture details than English literature. Regarding addressing trial design, English literature is better compared to Chinese literature.	The analysis concluded that both literature types needed to improve trial design in order to have a higher quality of reporting clinical evidence.

Li et al. (2017) (79)	(Only abstract available for review in English) A study analyzed fast acupuncture versus retaining acupuncture in the treatment of the cervical type of cervical spondylosis. The study randomized 60 participants into either the fast acupuncture group or the retaining needle group.	For both groups, the NPQ score decreased after treatment (both $P < 0.01$), and the fast acupuncture group had greater improvement ($P < 0.01$). For both groups, all components of the SF-MPQ were lower compared to the pre-treatment scores (all $P < 0.01$). The fast acupuncture group had better results regarding PRI sensation and PRI total score (both $P < 0.05$). Post-treatment, the PRI feeling score, VAS score, and PPI score were not significantly different between the two groups (all $P > 0.05$). With the fast acupuncture group's total effective rate being 83.3% (25/30), there was not a significant difference from the 76.7% (23/30) of the retaining needle group ($P > 0.05$).	The study concluded that both fast and retaining needle acupuncture were efficacious in improving the symptoms of cervical type of cervical spondylosis. The study found fast acupuncture to be better than retaining needle acupuncture.
Fejer et al. (2006) (5)	A systematic review examined fifty-six studies regarding the global prevalence of neck pain and differences in methods among the studies. The review investigated the MED- LINE, EMBASE, CINAHL, OSH- ROM, PsycINFO databases, and citation lists of related articles. Point, week, month, 6 months, year, and lifetime were the prevalence periods used to determine mean prevalence measurements. The quality of the studies did not influence the prevalence measurements.	Women described more neck pain compared to men in every prevalence period except for lifetime. Scandinavia appeared to have more neck pain compared to the remainder of Europe and Asia for the prevalence period of one year.	The review concluded that neck pain is a prevalent symptom and standardization of design is needed in subsequent studies.
Lorenc et al. (2018) (94)	A scoping review of systematic reviews examined the safety, efficacy, and cost-effectiveness of complementary medicine for treating musculoskeletal and mental health conditions. The review included 84 musculoskeletal systematic reviews and 27 mental health systematic reviews; only one of the reviews specifically addressed the musculoskeletal-mental health comorbidity.	Specifically regarding acupuncture, the systematic reviews provided fair/good quality evidence in a medium/large population for acupuncture treating low back pain, osteoarthritis, neck pain, myofascial trigger point pain. Acupuncture demonstrated safety in treating these conditions except there was some reported evidence of harm in acupuncture used in treating osteoarthritis. The review reported some evidence of acupuncture being an economical treatment option for low back pain.	The review concluded that yoga, mindfulness, and tai chi are the focuses of research regarding complementary medicine for musculoskeletal and mental health conditions; and additional better quality RCTs regarding comorbidity are needed.
Furlan et al. (2010) (75)	A systematic review of 265 RCTs and 5 non-RCTs regarding complementary and alternative medicine (CAM) therapies analyzed the efficacy, harms, and cost-effectiveness of acupuncture, massage, spinal manipulation, and mobilization in treating pain of the back, neck, and/or thoracic region. We will specifically address the findings of the acupuncture analysis. The review examined MEDLINE, cochrane central, cochrane database of systematic reviews, CINAHL, and EMBASE for literature published up to 2010. Additionally, the review searched for literature not yet published and reference lists from related articles.	In treating chronic nonspecific low back pain, acupuncture showed significantly reduced pain intensity compared to placebo, but only right after treatment. (VAS: -0.59, 95 percent CI: -0.93, -0.25). The review did not find a difference between acupuncture and placebo regarding intake of pain medication, overall improvement in chronic nonspecific low back pain, or post-treatment disability. Regarding decreasing chronic non-specific neck pain immediately post-treatment, acupuncture and sham-acupuncture did not differ (VAS: 0.24, 95 percent CI: -1.20, 0.73). Compared to no treatment, acupuncture improved pain intensity (VAS: -1.19, 95 percent CI: 95 percent CI: -2.17, -0.21), disability (PDI), functioning (HFAQ), well-being (SF-36), and range of mobility (extension, flexion), immediately post-treatment. Overall, the studies that involved sham-acupuncture more likely had statistically insignificant results versus studies which involved placebos such as laser therapy or medications. Studies produced less consistent results when compared to other treatments such as mobilization. When compared to conventional treatment or no treatment, acupuncture was more economical for treating chronic back pain.	The general conclusion of entire review was that CAM treatments appeared to be the most beneficial immediately or sooner after the conclusion of treatment. Additional better quality studies are needed in order to formulate decisive conclusions.

Liang et al. (2012) (88)	(ChiCTR-TRC-00000184) This article outlines the design and rationale of a randomized controlled trial that aims to evaluate acupuncture as a treatment for neck pain in the setting of cervical spondylosis. A total of 945 patients will be randomized to either the optimized acupuncture therapy group, shallow acupuncture, or sham acupuncture group. The intervention will last up to 4 weeks with 2 - 3 treatment sessions per week; a total of 8 - 10 sessions. The primary outcome measurement is the NPQ. The secondary outcome measurements are the MPQ and SF-36. Assessments will occur at baseline, at the conclusion of treatment, and at one month and three months post-treatment.		This article was published in 2012; and the published outcome of the study is not available per the Chinese Clinical Trial Registry.
Nasb et al. (2020) (70)	(ChiCTR800014723) A randomized pilot trial examined the effectiveness of ischemic compression therapy, dry cupping, and the combination of the two therapies in treating trigger points (TPs) associated with neck pain. The study randomized 24 patients to either receive ischemic compression therapy, dry cupping, or both. The outcome measurements included PPT, neck ROM, NDI; assessments were made at pre-treatment and at four weeks post-treatment.	All three groups demonstrated significant improvement the NDI, PPT, and neck ROM in comparison to the pre-treatment results ($P < 0.05$). The study did not find major difference between ischemic compression and dry cupping. The combination of the two treatment methods demonstrated more rapid and greater improvement ($P < 0.05$).	Based on the findings, ischemic compression and dry cupping may have individual efficacy in treating TPs. The combination of the two appears to be a more superior treatment option for TPs. The study recommends conducting a RCT.