SELINUS UNIVERSITY
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EFFICACY AND SAFETY OF ACUPUNCTURE AS A TREATMENT FOR MUSCULOSKELETAL SHOULDER PAIN MANAGEMENT IN COMPARISON TO OTHER AVAILABLE TREATMENTS AMONG ADULTS: A CRITICAL NARRATIVE REVIEW OF CURRENT SYSTEMATIC REVIEW EVIDENCE

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A DISSERTATION

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Abstract

The study's objective is to evaluate the efficacy and safety of acupuncture treatment for musculoskeletal shoulder pain in comparison to other available therapy or treatments. A narrative review of RCTs in which acupuncture was used as an intervention for patients with musculoskeletal shoulder pain (MSP) was conducted. All randomised controlled trials that evaluate the effects of acupuncture for musculoskeletal shoulder pain compared with controls were included. The primary outcomes were pain reduction and shoulder function. The secondary outcomes were the safety of acupuncture. Based on the inclusive and exclusive criteria, 22 randomized control trials involving 1801 participants that evaluated the effects of acupuncture for various shoulder pain disorders were retrieved from various databases, and the intervention and results were examined. Eleven studies found that acupuncture treatment had significantly greater effects when compared with other therapies or treatments. Nine studies showed that, when combined with other therapies or treatments, the acupuncture group showed a better therapeutic effect than the therapy group itself. Additionally, the findings demonstrate that acupuncture treatments can have the same therapeutic benefits as manual therapy, oral drugs, tropical NSAIDs, physical therapy, and corticosteroid injections. No significant adverse events were reported. Therefore, the findings indicated that acupuncture could be a safe and effective treatment for musculoskeletal shoulder pain by reducing pain and restoring shoulder functions. The results are consistent and align with those of past literature reviews. However, although there is some evidence for the effectiveness and safety of acupuncture for shoulder pain disorders, the level of evidence is currently low. Due to several limitations and heterogeneity, the results are inconclusive, and therefore the findings need to be interpreted with caution. Future large-scale studies ought to be more rigorous and well-designed RCTs with high-quality studies, a longer study duration with more subjects, an ideal standardized treatment regimen, and transparent reporting.

Key words: *acupuncture, musculoskeletal shoulder pain, acupuncture safety, alternative therapies, traditional Chinese medicine, pain relief*

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"When we express our gratitude, it grows."

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Murukesu M Margapandu

DEDICATIONS

"Dedication is belief transitioned into action which is transformed into change."

This dissertation is a tribute to my late parents, Mr. Margapandu Murugesu, a former senior headmaster, and Madam Sivapushani Murugesu, for their unwavering encouragement of my academic endeavors. My beloved wife, Santhi Ramanujam Gopala Krishnan, M.Ed. TESL, my adored daughter, Dr. Resshaya Roobini Murukesu, PhD, and my accounting-diligent son, Surreshvaraguhan Murukesu, BSc. Acc, all played key roles in the study's successful completion.

ABBREVIATIONS

AC	-Acromioclavicular
Ach	-Acetylcholine
ACJ	-Acromioclavicular joint
ACR	-Arthroscopy capsular release
ADL	-Ability in daily life
ANS	-Autonomic nervous system
AOF	-Accelerating Qi-flow along meridians
BMI	-Body Mass Index
CCP	-Anti-cyclic citrullinated peptide
CMS	-Constant-Murley Scale
CNS	-Central nervous system
CSP	-Chronic shoulder pain
CT	-Computerized tomography
DASH	-Disability of arm, shoulder and hand
EA	-Electroacupuncture
EMG	-Electromyography
ESR	-Erythrocyte sedimentation
ESWT	-Extracorporeal shock wave therapy
FMA	-Fugl-Meyer Assessment
FS	-Frozen shoulder
FT	-Full-thickness tear
GHJ	-Glenohumeral joint
GHOA	-Glenohumeral osteoarthritis
HAMA	-Hamilton Anxiety Sclae
HSP	-Hemiplegic injury shoulder pain
MAPK	-Mitogen-activated protein kinase

MSP	-Musculoskeletal shoulder pains
MRA	-Magnetic resonance arthrography
MRI	-Magnetic resonance imaging
MUA	-Manipulation under anesthesia
NRS	-Numeral Rating Scale
NSAID	-Non-steroidal anti-inflammatory drugs
OA	-Osteoarthritis
PETS	-Physical examination test of the shoulder
PGA	-Physician Global Assessment
PT	-Physical training
QOL	-Quality of life
RCT	-Randomized control trial
ROM	-Range of motion
SLAP	-Superior labral anterior and posterior
SP	-Should pain
SPADI	-Shoulder pain and disability index
TCM	-Traditional Chinese medicine
TENS	-Transcutaneous electric nerve stimulation
TG	-Treatment group
TLR	-Toll-like receptor
ULCA	-University of California at Los Angeles Shoulder Score
US	-Ultrasound
USG	-Ultrasonography
VAS	-Visual analog scale
WHO	-World Health Organization

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CHAPTER 1

INTRODUCTION

"I always tell my students and researchers here: if you try something, you might not get the result you wanted. But if you never try it, you definitely won't get it."

This Chapter provides the background, rationale, research gap, aims, objectives, hypothesis, and the thesis outline.

1.1 Background

One prevalent and significant musculoskeletal issue is shoulder pain. Pain on elevation of the arm is a common symptom of various shoulder pain (Svendsen et al., 2004). Shoulder pain is not an underlying condition; rather, it is a symptom. Musculoskeletal shoulder pain (MSP) is referred to as any level of pain or discomfort in or around the shoulder joint. It may arise from the shoulder joint itself or from any of the many surrounding muscles, ligaments, or tendons (Murphy & Carr, 2010). Common MSP shares overlapping clinical features. Since the shoulder joint is one of the most movable joints in the human body, shoulder pain can have a wide range of etiologies, either from intrinsic disorders of the shoulder or referred pain (Tidy, 2021).

The common symptoms of shoulder pain are chronic stiffness in the shoulder that is worse at night and in the morning, excruciating pain in the shoulder when reaching overhead or behind the back, a dull ache in the shoulder that worsens when moving the arm up or to the side, sharp pain in the front and side of the shoulders that radiates toward the elbow, and extreme shoulder pain initially, followed by stiffness (Goad, 2021). Other symptoms are weakness, numbness, and limitation of shoulder movements (Martin &

Gabica, 2009). Besides that, a clicking, popping, or grinding sensation can be felt when moving the arm. Some warmth or redness may be present in the shoulder area (Pathak, 2021; Haddad, 2016).

Several issues can cause pain or discomfort in or around the shoulder joint. The common causes are rotator cuff problems, frozen shoulder, tendonitis, tendon rupture, SLAP (superior labrum anterior-posterior) tears, osteoarthritis, arthritis, AC (acromioclavicular) separation, osteolysis, shoulder instability, impingement, and dislocation (Cluett, 2022; Tidy, 2021; Lathia, Jung, & Chen 2009). Other causes include pinched nerves, referred pain, bone spurs, heart attack, and stroke (Pathak, 2021).

Regardless of the disorder, MSP is one of the most common musculoskeletal and disabling complaints in primary care (Schwarzkopf, Oron, & Loebenberg, 2008; Cadogan, Laslett, Hing, McNair, & Coates, 2011). It is the third most common musculoskeletal presentation after back and knee pain (Artus, Holt, & Rees, 2014), with an estimated prevalence of 4% to 26% in the global population (Murphy, & Carr, 2010). According to population surveys, shoulder pain affects 18 to 26% of adults at any point in time (Luime, Koes, Hendriksen, Burdorf, Verhagen & Miedema, 2004), making it one of the most common regional pain syndromes. According to reports, the prevalence of shoulder pain in the general population ranges from 7% to 30%, and it increases with age, with women having a higher prevalence than men (Pribicevic, 2012).

Shoulder pain is still common in workers over the age of 50. Prevalence continues to increase in physically demanding occupations (Hodgetts, 2021). Recovery from shoulder pain can be slow, and recurrence rates are high, with 25% of those affected by shoulder pain reporting previous episodes, and 40 to 50% reporting persistent pain or recurrence at 12-month follow-up (Cadogan, Laslett, Hing, McNair, & Coates, 2011).

Shoulder disorders symptoms due to musculoskeletal shoulder pain can be persistent and disabling in terms of an individual's ability to carry out everyday tasks at home and at work (Kuijpers et al., 2004). Shoulder pain that goes untreated will have a substantial impact on a person's ability to carry out daily tasks, resulting in a lower quality of life. Research shows that shoulder pain intensity is inversely related to subjective quality of life and physical activity (Gutierrez, Thompson, Kemp, & Mulroy, 2007). These conditions become more common with increasing age or certain work-related or sporting activities (Weiss, 2018).

The impact of musculoskeletal shoulder pain has resulted in a significant socioeconomic burden on society (Gutierrez, Thompson, Kemp, & Mulroy, 2007; Struyf & Meeus, 2014; Laumonerie et al., 2020). Besides that, there are also substantial economic costs involved with increased demands on health care, impaired work performance, substantial sickness absence, and early retirement or job loss (Palmer, 2012). In Sweden, costs for sick leave for shoulder pain contributed to more than 80% of the total costs for society for this patient category (Virta, Joranger, Brox, & Eriksson, 2012). MSP are the second most expensive disease group for health care costs in the Netherlands and represent 6% of the total healthcare costs (Kuijpers et al, 2006).

The diagnosis of shoulder pain often starts with a general inspection looking for musculoskeletal abnormalities and any associated functional deficits. Some specialized tests will be performed to detect any lesions in the muscular or ligamentous structures of the joint. Before moving on to the shoulder, a thorough examination of the cervical spine will be performed to ensure that no spinal pathologies are contributing to the presentation. Then the test for joint stability and range of motion (ROM) of the shoulder in different directions will be carried out (Pietrangelo, 2019). If movement in a specific direction is painful or limited, this may indicate that pathology is present in a specific structure of the

shoulder. Further diagnosis for shoulder pain may include an x-ray, MIR scan, CT scan, EMG, or arthroscopy (Pathak, 2021). General treatment for shoulder pain will depend on the cause and severity of the pain. Some treatment options include physical or occupational therapy, a sling or shoulder immobilizer, or surgery (Barrell, 2019). Seladi-Schulman (2020) suggests that minor shoulder pain can be treated at home by icing the affected shoulder for 15 to 20 minutes three or four times a day for several days to help reduce the pain. Johnson (2019), discovered that resting the shoulder for several days, avoiding any motions, and restricting overhead work or activities before resuming normal activity may assist in alleviating the pain.

Nonsurgical treatment is effective for the majority of shoulder pain etiologies. Some systematic reviews have reported on various nonsurgical treatments available, such as pharmacotherapy (corticosteroid or hyaluronate injections, glucocorticoid injections, steroid injections, oral analgesics, and non-steroidal anti-inflammatory drugs [NSAIDs]), (Cho, Bae, & Kim, 2019). In any case, studies reveal that the majority of pharmacotherapy has a wide spectrum of adverse effects. Side effects of oral analgesic medications are a well-documented barrier to successful pain management (Villars, 2007). Oral analgesics do not treat the disorders but help by changing the way the body senses pain and reducing the pain signals sent by the nervous system and the brain's reaction to those pain signals (Marks, 2015).

The common side effects of oral analgesic medications are nausea or vomiting, constipation, sedation, cognitive failure, myoclonus, and pruritis (Rogers, Mehta, Shengelia, & Reid, 2013). NSAIDs have well-known adverse effects affecting the gastric mucosa, renal system, cardiovascular system, hepatic system, and hematologic system (Ghlichloo & Gerriets, 2021). Hyaluronic acid injections may work better than painkillers for some people with osteoarthritis, but they may be less effective in older adults and

people with severe osteoarthritis (Dunkin, 2021). If pharmacotherapy or nonsurgical options do not provide the desired pain relief or return of function, surgery may be necessary in some conditions to correct and restore the shoulder.

The new guidelines encourage nonpharmacological therapies such as physical therapy, exercise therapy, manual therapy, and extracorporeal shockwave therapy as the first-line treatment for various types of shoulder pain (Jancuska, Matthews, Miller, Kluczynski, & Bisson, 2018; Pieters, 2020). Tick et al. (2018), detailed a few evidence-based nonpharmacologic therapies for pain management, such as acupuncture therapy, massage therapy, osteopathic and chiropractic manipulation, meditative movement therapies, Tai chi and yoga, mind-body behavioral interventions, dietary components, and self-care/self-efficacy strategies.

Among the nonpharmacological therapies, acupuncture appears to be one of the most effective and safe treatment for musculoskeletal shoulder pains. The effectiveness of acupuncture treatment for shoulder pain is supported by clinical evidence (Shi et al., 2018; Chau et al., 2018). Research showed that acupuncture helps relieve pain, reduce inflammation, release tight muscles, and increase range of motion for a variety of shoulder problems (Tukmachi, 1999; da Costa, 2014; Guyver et al., 2014). It is amazing that acupuncture is still widely practiced despite its alleged origins in China thousands of years ago.

All over the world, acupuncture use is growing fast (Jishun & Mittelman, 2014). Acupuncture is currently used, not only by practitioners of the school of traditional Chinese medicine (TCM), but also by Western-trained medical professionals who recommend it, particularly for the treatment of musculoskeletal conditions (Brazkiewicz, 2021). Both patients and healthcare professionals are starting to accept it more.

There is no doubt that numerous studies have indicated the beneficial effects and safety of acupuncture for several chronic pain conditions (Kligler & Quick, 2016; Xiang, Cheng, Shen, Xu, & Liu, 2017; Yuan et al., 2016), but there are other studies that question the effects and safety of acupuncture. The current understanding of the effects of acupuncture and its adverse events is fragmented (Chan et al., 2017).

This question arises when reference is made to non-randomized studies. Clinical researchers favor randomized clinical trials instead of non-randomized clinical trials, as randomized clinical trials (RCTs) are the gold standard study for the evaluation of health interventions and are considered the second level of evidence for clinical decision making (Flecha et al. 2016). The argument about the effectiveness and safety of acupuncture for shoulder pain is still on-going. But, at present, there are no proper narrative reviews conducted to evaluate the effect and safety of acupuncture treatment for musculoskeletal shoulder pain in adults. As a result, it is now necessary to conduct a critical narrative review of the effect and safety of acupuncture treatment for adult musculoskeletal shoulder pains.

1.2 The rationale of the study

The purpose of this research is to evaluate the efficacy and safety of acupuncture treatment for musculoskeletal shoulder pain (MSP) in adults. To achieve its purpose, the study must be critically reviewed in terms of the effectiveness and safety of acupuncture treatment for musculoskeletal shoulder pains. Acupuncture treatment is becoming the leading non-pharmaceutical intervention for shoulder pain in the present world, yet its effectiveness and safety is still not fully accepted into the conventional medicine system due to its lack of solid quantitative scientific evidence. Most of the scientific evidence-

based findings are based on quantitative research methods derived from randomize-control trials and systematic reviews, whereas most research in the field of alternative medicine, such as acupuncture, is non-randomize-control trial-based and qualitative in nature. So much so, the results of qualitative research that cannot obtain quantitative outcomes tend to be ignored or excluded in the safety of the systematic review process (Bae, 2014).

As a result, findings of effectiveness in those fields are always limited because most of them are considered non-evidence-based medicine. However, Rapport et al. (2013) reported that, in line with the trend toward improving medical treatment quality through patient-centered and evidence-based diagnostic and therapeutic service efforts for complementary medicine, the utilization of qualitative research results has experienced a revival in recent years. Bastian (2010) reports that lately, narrative reviews form the basis of medical literature synthesis, and their number per year in MEDLINE has significantly surpassed that of systematic reviews.

Therefore, narrative review was selected as the research method for this study. It is a qualitative approach by nature. I am aware that to prepare a narrative review in clinical research, the quality of the narrative review must be improved. According to Ferrari (2015), this can be done by synthesizing some systematic review guidelines that are aimed at reducing bias in the selection of articles for review and employing an effective bibliographic research strategy.

Efforts have been made to incorporate three of the most important guidelines from systematic reviews into narrative reviews, such as: the literature search method; search terms using keywords to select related articles and eliminate those that are not relevant; and selection criteria, which determine inclusion and exclusion for literature selection.

The literature search method is important because it adds clarity to the key messages of narrative reviews, which also determines the selection bias. The selection criteria are important too, as they help in focusing on the relevance of the research to the topic (Snyder, 2019).

As a result, the focus of this research is to provide in-depth knowledge of acupuncture for musculoskeletal shoulder pain and illuminate some challenges that exist in establishing evidence for the efficacy and safety of acupuncture.

The research was completed by conducting a critical narrative review of data retrieved from research databases relevant to the research topic.

1.3 Research gap

Acupuncture is increasingly being used as an integrative or supplemental pain treatment (Kelly & Willis, 2019). Even though it is increasingly being used to treat musculoskeletal pain for its analgesic benefits (Green, 2005; Wang et al., 2021), the use of acupuncture in musculoskeletal shoulder pain has yet to be critically analyzed in a narrative review.

According to previously published literature sources, the clinical effects and safety of acupuncture treatment have not been sufficiently subjected to an extensive qualitative analysis in assessing their effectiveness and safety in treating musculoskeletal shoulder pain in adults.

Therefore, the purpose of this critical narrative review was to assess the effectiveness and safety of acupuncture treatments for managing symptoms and shoulder function in patients with MSP.

1.4 Aims, and objectives of this thesis.

The aim of the research is to determine two aspects: first, whether acupuncture treatment could provide fast and effective relief for musculoskeletal shoulder pains, restoring disability and life improvement; and second, whether acupuncture treatment is safe without any adverse effects for musculoskeletal shoulder pain in comparison to other available therapy or treatments. The objectives of the research are to:

a. examine the background knowledge of acupuncture and musculoskeletal shoulder pain from both the Traditional Chinese Medicine (TCM) approach and the Western Medicine approach;

b. evaluate the effectiveness of acupuncture treatment for musculoskeletal shoulder pain in terms of promoting fast and long-term pain relief and resulting in improved life quality by critically review and analyzing research databases based on currently available sources from reliable academic research databases; and

c. critically examine the currently available research database to determine the safety of acupuncture treatment for musculoskeletal shoulder pain with minimal adverse effects.

1.5 The hypothesis of this study

In order to achieve the objectives of the study, the following hypotheses are considered:

a. Null Hypothesis ($H1_0$)

   In comparison to other available treatments, acupuncture is ineffective in treating musculoskeletal shoulder pain by promoting immediate and long-

term pain relief, disability restoration, and improved quality of life.

b. Alternative Hypothesis ($H1_1$)

In comparison to other available treatments, acupuncture is effective in treating musculoskeletal shoulder pain by promoting immediate and long-term pain relief, disability restoration, and improved quality of life.

c. Null Hypothesis ($H2_0$)

In comparison to other available treatments, acupuncture is not a safe treatment option for musculoskeletal shoulder pains.

d. Alternative Hypothesis ($H2_1$)

Acupuncture is much safer than other available treatments for treating musculoskeletal shoulder pains, with no serious adverse effects.

1.6 Thesis outline

The whole thesis is divided into seven chapters. Chapter One provides a general introduction to the background, rationale, research gap, aims, objectives, and hypothesis of the study. Chapter Two provides a comprehensive literature review of the study of acupuncture and traditional Chinese medicine approaches for musculoskeletal shoulder pains. It covers the introduction, history, anatomy, traditional therapies, TCM views on modern therapies, the TCM approach to MSP, and acupuncture for MSP. Chapter Three provides a comprehensive literature review of the study of western medicine approaches for MSP and western acupuncture for MSP. It covers the following: introduction, anatomy, mechanism, symptoms, causes, risk factors, epidemiology, prevalence, impact, diagnosis, current intervention, assessments, complementary and alternative therapies, western

acupuncture, scientific evidence, safety, and existing reviews. In Chapter Four, the methods used for narrative reviews are described in detail, with some modifications from those used for systematic reviews. Chapter Five reports the research findings of the reviews. Chapter Six discusses the research findings. Chapter Seven draws the general conclusions of all the research findings in this study

CHAPTER 2

Acupuncture addresses the physical, mental, and emotional imbalances that give rise to the symptoms.

LITERATURE REVIEW ON ACUPUNCTURE AND CHINESE MEDICINE APPROACHES FOR MUSCULOSKELETAL SHOULDER PAIN MANAGEMENT

This chapter provides a thorough review of the literature on acupuncture and traditional Chinese medicine approaches for musculoskeletal shoulder pain (MSP) management. The whole chapter is divided into subtopics such as introduction, history, anatomy, techniques, mechanisms, traditional theories, TCM approach, and acupuncture for musculoskeletal shoulder pain management.

2.1 Introduction to Acupuncture

Acupuncture is a form of alternative medicine based on ancient Chinese medicine that is more than 3,500 years older than traditional Western medicine (Cosio & Lin, 2015). It is one of the world's oldest healing practices, used to restore and maintain health by stimulating specific points in the body (Litscher, 2009). Acupuncture was originally intended to be used to prevent medical conditions, but it can also be used to relieve a wide range of medical conditions. Acupuncture aims to maintain and restore health through balancing the body's energy system. Although it has roots in traditional Chinese medicine (TCM), it is now a common complementary treatment worldwide (Brazier, 2022).

The term "acupuncture" encompasses a broad spectrum of procedures that involve the stimulation of anatomical locations or points on the body using a variety of techniques (Hsiao & Tsai, 2008). The most widely researched scientific acupuncture technique

involves penetrating the superficial skin, subcutaneous tissue, and muscles of the body at a specific point with fine, solid, metallic needles that are manipulated with the hands or by electrical or laser needle stimulation for therapeutic or preventative purposes (Lim et al., 2018). It is a minimally invasive method to stimulate nerve-rich areas of the skin's surface in order to influence tissues, glands, organs, and various functions of the body (Sinay, 2018). Acupuncture has grown in popularity in the West over the last few decades (Stenger, Bauer, & Licht, 2013), and it is now accepted as a treatment option at some of the country's top academic medical centers and hospitals.

According to the World Health Organization report (WHO, 2019), acupuncture is the most widely used traditional and complementary medicine, being used in 113 out of 120 countries. With the increasing use of acupuncture in clinical settings around the world, WHO (2021) developed acupuncture practice benchmarks against which actual acupuncture treatment can be compared and evaluated. This document provides step-by-step instructions for administering, procedures, and facilities, and ensures the safety of acupuncture treatment and services.

Musculoskeletal and connective tissue disease; neurological disorders; obstetrics, gynecology, and women's health; oncology; and gastrointestinal disorders were the most recommended conditions for acupuncture (Dobos et al., 2012; Cho et al., 2014; Tang et al., 2022). Acupuncture for pain management has changed the lives of many people over the last 40 years. In addition to pain management, scientific research is increasingly supporting the use of acupuncture in the treatment of a wide range of conditions. Acupuncture practitioners are increasingly leading efforts to inform and educate medical professionals and the general public about the widespread use and evidence base of acupuncture (Hao & Mittelman, 2014).

2.2 A Look Back at Acupuncture's History

Acupuncture is one of the oldest forms of medicine, dating back over 5000 years, and is widely believed to have originated in China (Chong, 1991). It was first mentioned and documented in documents dating back several hundred years before the Common Era (White & Ernst, 2004). Acupuncture was first used for medical purposes over 2,500 years ago in China. The first detailed written description of acupuncture diagnosis and treatment is thought to have appeared in a document known as Huangdi Neijing (The Yellow Emperor's Classic of Internal Medicine) around 100 BCE (Curran, 2008). Acupuncture needles in ancient China were made of bone, stone, bamboo, silver, gold, and other materials. They are now made of high-quality stainless steel and are disposable.

Acupuncture quickly spread to neighboring countries after becoming a well-established practice in China. Acupuncture is thought to have spread to nearby Korea before spreading to Vietnam and Japan. It eventually made its way to Europe in the second half of the 17th century. The term "acupuncture" first appeared in the Dutch text "De Acupunctura," which popularized this type of medical treatment in the Western world. Its popularity, particularly in the West, can be attributed in part to its effectiveness for pain relief, as well as the fact that scientific studies have begun to demonstrate its efficacy (Hao & Mittelman, 2014).

Acupuncture, as practiced in the United States, has emerged as an evidence-based therapy in a growing number of multidisciplinary guidelines in recent years, with most of these guidelines focusing on its use for pain (Miller et al., 2021). Rooted in traditional Chinese medicine (TCM) and modern medical science, today’s acupuncture practices across the United States are a unique integration of the old and new, east, and west.

2.3 Anatomy of Acupuncture in Traditional Chinese Medicine (TCM)

Acupuncture is an ancient Chinese practice in which small needles are inserted into the body at particular locations, or "acupoints." These points are believed to be found along “meridians”, which are channels that run through the body and are frequently represented as lines on its surface.

A number of anatomical structures have been proposed to describe meridians, but no research has verified the existence of these meridians as physical entities (Helms, 1998). The morphological basis for the concept of meridians in TCM is unknown. Recent research suggests a link between acupuncture points, meridians, and fascia (Bai et al., 2011). Anatomical observations of body scan data revealed that the fascia network closely resembles the theoretical meridian system in significant ways, and physiological, histological, and clinical observations support this hypothesis (Kim & Kang, 2014; Li et al., 2008).

Ancient Chinese scholars discovered that certain points on the body (where there exists a vortex of energy), when stimulated by massage, needles, moxa, guasa, or cupping, affect the balance and flow of energy (Marcelli, 2013). The effects of this stimulation can relieve pain or produce curative effects on certain disorders. These particular points are referred to as acupuncture points (acupoints). Acupoints are the points at which "Qi" (‘vital energy’ or 'vital force’) and blood are transported from the Zang-Fu organs (a *Wu Xing* cycle of 5 *zang* organs, 6 *fu* organs), and meridian to the body surface, where acupuncture therapy takes effect (Jiang & Zou, 2013). According to Lin et al. (2012), acupuncture points are special locations in the body where the "Qi" of viscera and meridians infuses and effuses. They are also called “points”, “underground channels” and “cavity”. Acupuncture points are typically found in deep depressions of muscles, joints, or bones

and are often pressure sensitive. There are numerous acupoints on the body's surface, which are generally classified into three categories: meridian acupoints, extra acupoints, and ouch or "ashi" points. The 14 meridians' acupoints, also known as "regular points," are distributed along the twelve meridians as well as the Governor and Conception Vessels. Extra points are points that are not assigned to the 14th meridian.

WHO has classified 48 standards extra acupoints. Some of the extra acupoints are located along the 14 meridians. In addition to regular and extra points, ouch or "ashi" points (a regional reactive site) can be used as acupuncture points in clinical practice. Ouch points, also known as "ashi" points, are acupuncture points that do not have a specific name or location. Tenderness or other pathological responses determine the location of each aching point (Hwang & Jung, 2018). These acupoints are commonly used in traditional Korean medicine (TKM) and TCM to treat musculoskeletal issues.

According to traditional Chinese medicine (TCM), acupuncture points are linked together in a network of channels called meridians (*Jing Lou*) that run along the surface of the body. Wang, Ayati, and Zhang (2010) described how meridians (invisible channels) are pathways for the flow of "Qi" and "blood," (the two fundamental bodily fluids in Chinese medicine). Meridians run vertically and horizontally across the entire body, connecting the inside and outside of the body. They also connect the internal organs, joints, and extremities, effectively transforming the entire body into a single organ (Marcelli, 2013).

The names of the twelve meridians are determined by the “Yin” and “Yang” characteristics, corresponding organs, and limb positions. According to Lin et al. (2018) there are three leg Yang meridians (stomach, gall bladder, and bladder), three leg Yin meridians (spleen, liver, and kidney). three arm Yang meridians (large intestine, triple

burner, and small intestine), and three arm Yin meridians (lung, pericardium, and heart). The terms "triple burner" and "pericardium" do not refer to actual physical parts of the body. However, in traditional Chinese medicine, they are useful units.

Additionally, it should be noted that in TCM, the meaning of the organs is much more expansive than what is typically believed to be their functions in western medicine. The twelve meridians are referred to as the regular or principal channels because they make up the majority of the Meridian System.). Figure 1 illustrates the location of meridians (channels) in the human body according to the TCM concept.

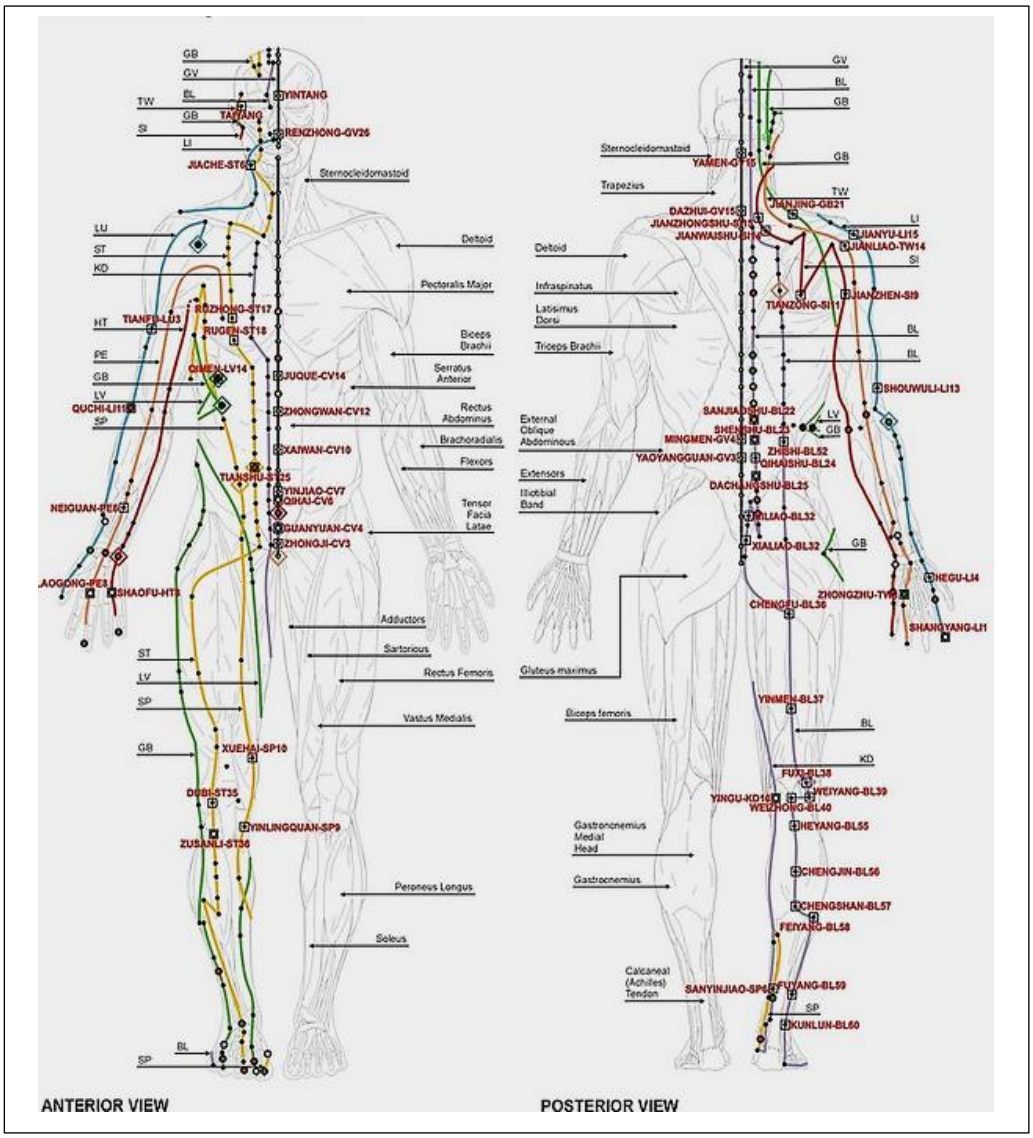


Figure 1: The main meridian of the human body.

Acupuncture points are typically found in deep depressions of muscles, joints, or bones and are often pressure sensitive. Several studies have been conducted to investigate the accuracy and precision of acupuncture point location using various point location methods (Godson & Wardle, 2019).

Accuracy in point location is critical for safe, efficacious, and dependable treatments, as well as valid, reproducible research outcomes. The Chinese anatomical inch (cun) measurement system is an important part of the traditional acupuncture point location methods (Coyle, Aird, & Cobbin, 2000).

When determining the locations of acupuncture points on the body, a unit of measurement known as a "tsun" or "cun" is used (Godson & Wardle, 2019). Anatomically, there are many methods to describe meridians or acupuncture point locations. The principles and methods of the WHO's standard acupuncture point location guidelines (WHO, 2008) were used to locate acupoints on the skin's surface.

Three combined methods were used with these guidelines to locate acupoints: (1) the anatomical landmark method, (2) the proportional bone (skeletal) measurement method, and (3) the finger–cun measurement method.

The first method is called the "anatomical landmark method." It uses special anatomical language. Figure 2 illustrates an example of the anatomical landmark method. Special terminology is used to prevent misunderstandings. The exact terms are used for position, direction, region, and structure. An example for locating Gall Bladder (GB20 Fengchi). GB 20 is located at the base of the skull, within the sub occipital muscles. In the depression created between the origins of the Sternocleidomastoid and Trapezius muscles,

at the junction of the occipital and nuchal regions. GB 20 uses the terminology “1.5 cun” below GB 19, on the Pupiline line, lateral and level with GV16.

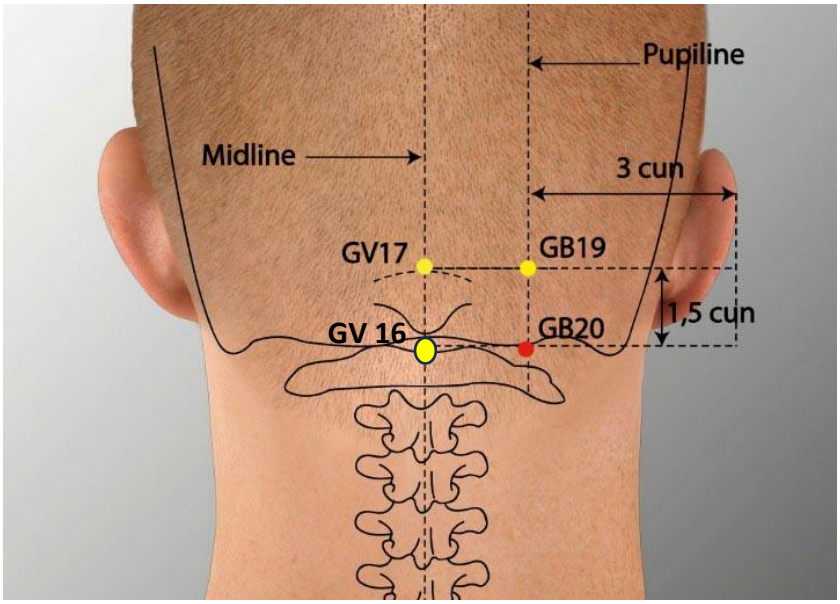


Figure 2: Anatomical landmark method.

The second method is “the body or bone proportional measurement method.” This method takes as its basis that in an average person the various parts of the body are generally in relative proportion to each other. In “cun” measurement, therefore, the would be a constancy of length from person to person, regardless of body builds. Based on this pricipals, the distance between certain important anatomical landmarks have been noted in order to facilitate the location of acupuncture points.

According to cun measurements, the proportional method divides the distance between two anatomical landmarks into equal portions (Godson & Wardle, 2019). Figure 3 illustrates the standards for bone proportional measurement in cun.

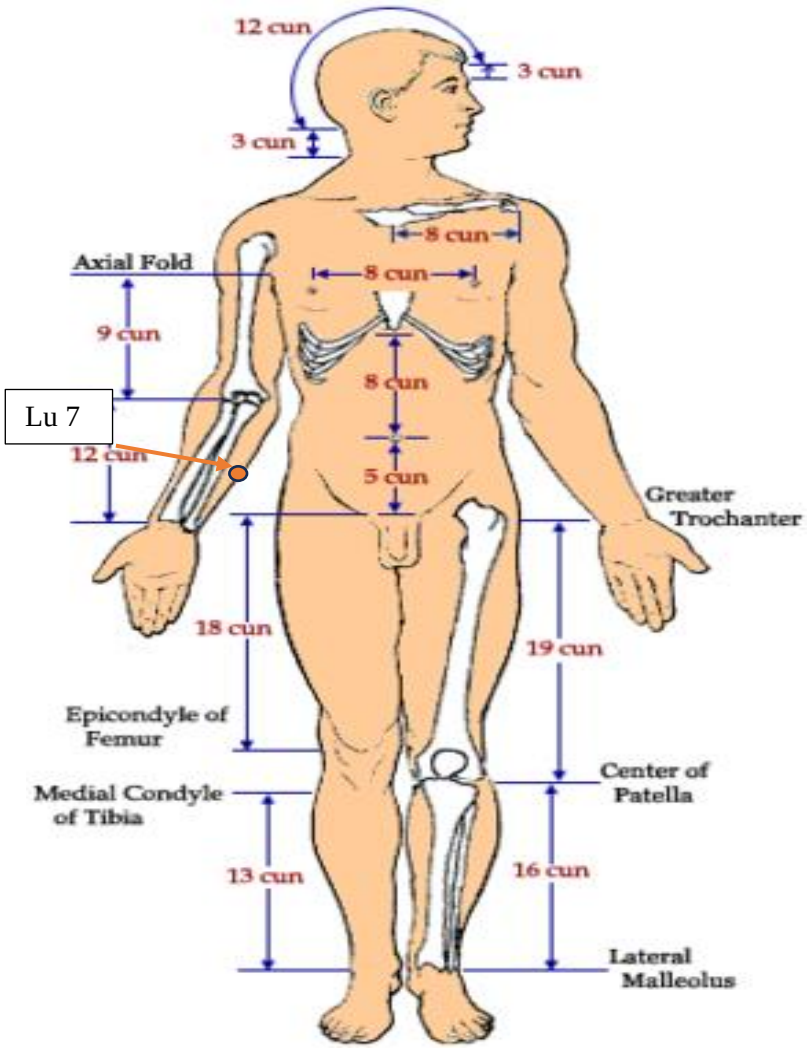


Figure 3: Standards for bone proportional measurement in cun

An example for LU 7 is “1.5 cun” above the transverse crease of the wrist, superior to the styloid process of the radius.”

The third method is “the finger measurement, or finger cun method.” A cun, also known as the Chinese inch (寸 ts'wun in Chinese), is a conventional measure of length used in China. Its traditional measurement is the width of a person's thumb at the knuckle; two forefingers' width equals 1.5 cun, and four fingers—aside from the thumb—measure three cuns.

According to this method, the body inch, or the body cun is based on the patient's finger. One cun is equal to the breadth of the thumb. The measurements are taken in two ways: (1) using the width of the thumb's distal interphalangeal joint (first finger) or (2) using the distance between the 3rd (middle) finger's distal and proximal interphalangeal joints.

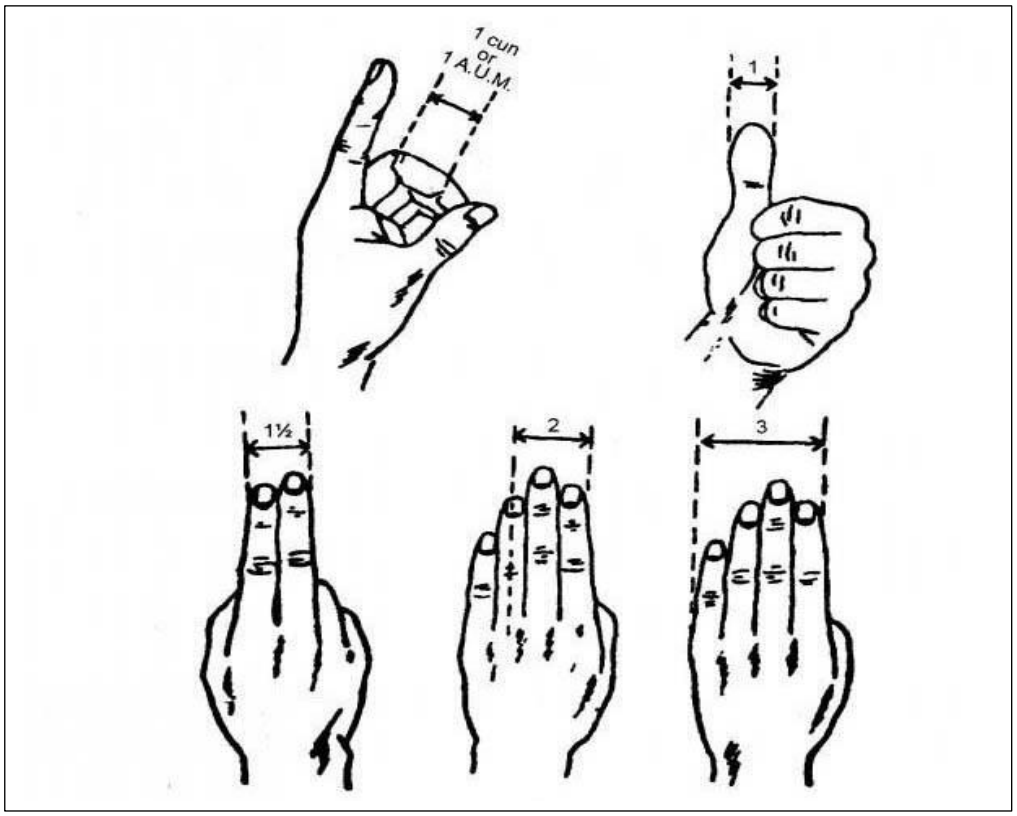


Figure 4: Finger measurement for acupuncture.

The width of the index and middle fingers added together equals 1.3 cun, and the width of all four fingers added together equals 3 cun. Figure 4 illustrates the finger measurement for acupuncture.

There is another additional method called "simple convenient location." An example is the SP 10 (XueHai), with the knee in flexion, 2 cun superior to the superior border of patella, on the bulge of the medial portion of the quadriceps femoris muscle (Xu

et al., 2022). Figure 5 illustrates a simple and convenient location method for locating an acupuncture point.

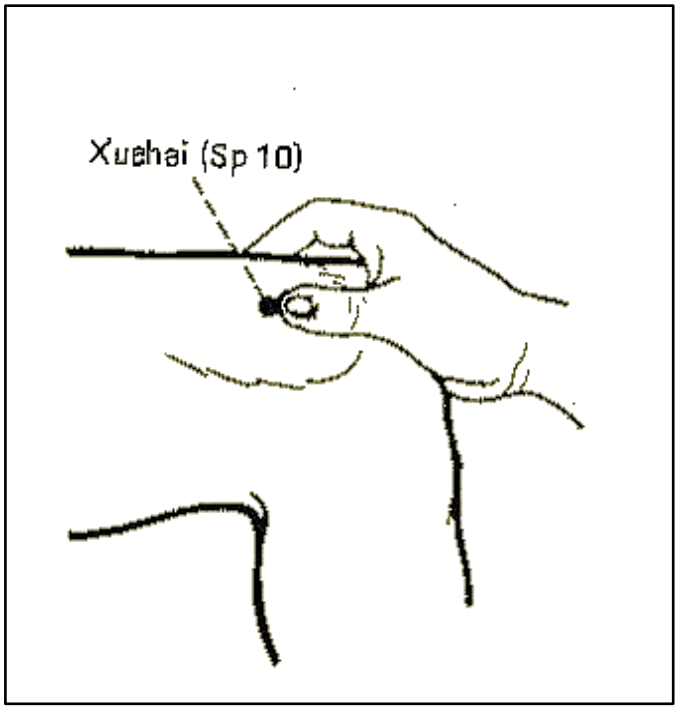


Figure 5: A simple convenient location method

The cun measurement system has been widely used in the practice of acupuncture as an essential and convenient method of locating acupoints (Kim & Kang, 2015). Traditional cun measurement methods, on the other hand, have been criticized for being unreliable. According to Marcelli (2013), as long as there is no correspondence with gross anatomy, there will be a lack of biomedical scientific evidence for the existence of channels or meridians in the acupuncture system. However, new technology is now available to measure soft tissue and bone mass independently (Park et al., 2006).

The patient's posture is also very important for the correct location of the acupuncture points. Many acupoints can only be exposed when the patient is in the proper posture (refer to Figure 6).

Supine posture, prone posture, lateral recumbent, sitting straight, sitting in flexion, sitting with an inclining position, flexing the elbow with palms upward, flexing the elbow with palms downward, and flexing the elbow with palms inclined are the most common postures in practice (Chu et al., 2018).

Figure 6: Eight common patient positions during acupuncture treatment

2.3.1 Acupuncture needles and needling technique

Acupuncture is a complementary therapy that involves inserting very thin needles into the body. Needles are inserted at various depths and locations, primarily to relieve pain, but they have also been used to treat other conditions. (Brazier, 2022).

2.3.1.1 The mechanics of Needle Technique

Needling techniques are critical to achieving effective acupuncture in practice. Their primary goals are to induce Qi sensation and provide either a reinforcing or a reducing effect (Jiang & Liu, 2005). Five Element Constitutional Acupuncture practitioners use two needle techniques: 'tonification' and 'sedation' (Park & Kim, 2015).

Tonification is the most common needle technique used in Five Element Constitutional Acupuncture. When a patient's Qi is deficient, the tonification needle technique is used to strengthen it.

This method entails inserting a needle into the patient's Qi and then immediately removing it. The entire technique usually lasts two to three seconds. When there is an excess or full condition, a sedation needle technique is used to calm a person's Qi.

This technique entails contacting the patient's Qi and then leaving the needle in place for twenty to thirty minutes, or until the pulses have changed sufficiently.

2.3.1.2 Stages of Needle Technique

There are a few stages involved in acupuncture needling: needle angles, needle order, needle insertion, depth of needle insertion, needle manipulation, needle sensation, length of needle retention, needle removal, and needle closing. Each stage is important and must proceed with full caution.

Needle angles

For tonification, the needle angle should be 10 degrees toward the flow of the Qi, whereas for sedation it is 10 degrees against the flow. Refer to Figure 7

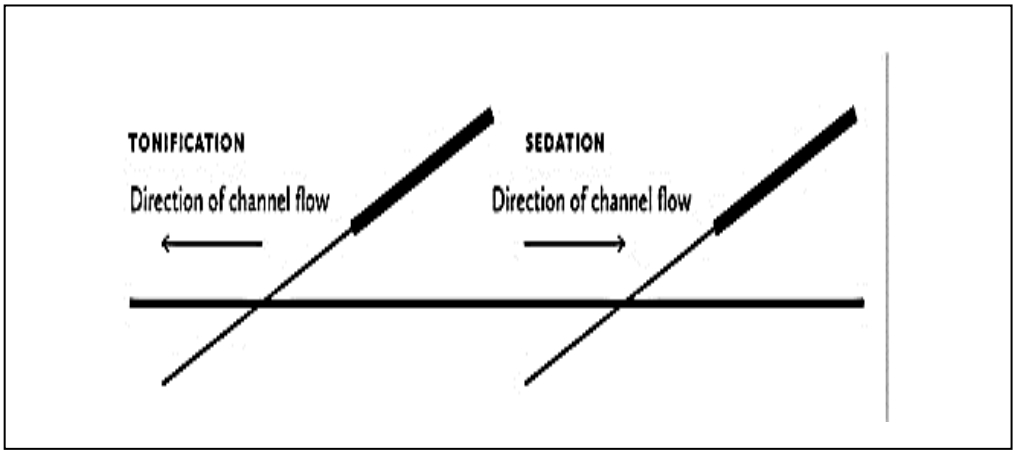


Figure 7: Needle angle for tonification or sedation

- **Needle order**

  For tonification, the needle is inserted into the left side first, then the right side, whereas for sedation, it is the opposite.

- **Needle insertion**

  For tonification, the needle is inserted slowly as the patient breathes out, whereas for sedation, it is the opposite action.

- **Depth of needle insertion**

  The depth of insertion varies (shallow or deeper) depending on the point used.

- **Needle manipulation**

  A needle is usually inserted to the required depth.

  Then it is turned gently to make contact with the patient's Qi. It rotates continuously at 180 degrees for tonification and 360 degrees for sedation. Refer to Figure 8.

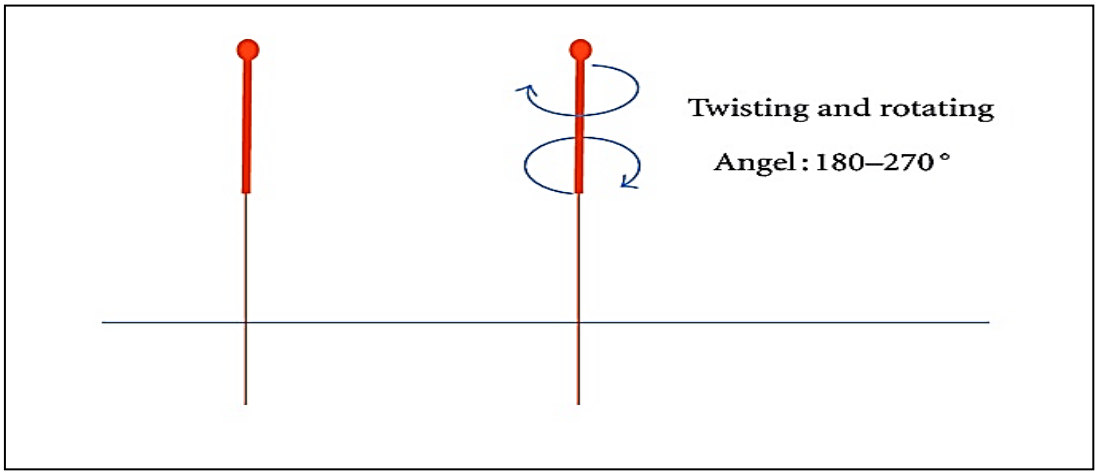


Figure 8: Needle twisting and rotation for tonification or sedatiom.

- **Needle sensation.**

  The Qi is usually felt by the patient as a dull ache, soreness, heaviness, a pulling sensation, heat, or numbness.

  A pulling sensation is usually felt by the practitioner at the same time.

- **Length of needle retention**

  The needles are not retained for tonification. In contrast, needles are kept in place for sedation until the desired pulse change occurs (from 5 to 30 minutes).

- **Needle removal.**

  In most cases, the needles are left in place for 10 to 15 minutes while the patients lie still and relax.

  When the needles are removed, there is usually no pain felt by the patient.

- **Closing the needle hole**

  The needle holes are closed with a clean swab for tonification, but not for sedation.

2.3.1.3 Stimulating with the needle

Stimulation is typically done manually or electrically. Manual stimulation can include lifting and thrusting, rotation, or a combination of the two, as well as scraping or vibrating the needle (Perreault et al., 2017).

Electrical stimulation is more convenient and has the additional benefit of being more precisely regulated (Inverarity, 2022).

2.3.1.4 Needling sensations (DeQi)

Traditional Chinese physicians referred sensation felt during needling as "deQi". DeQi, a composite of unique needle sensations, namely, Qi sensation under the tip of needles and Qi sensation at the affected region (Chen et al., 2013). The deQi sensation felt during needling indicates that the needle was inserted at the correct point and depth, resulting in better therapeutic results (Yuan et al., 2013; and Hu et al., 2019).

2.3.1.5 The main curative law of acupuncture.

The regularity of acupoint therapy is the main curative law of acupuncture (Wang et al., 2014). Acupoint functions are distinguished by three curative effects: proximal curative effects (closer to its origin), distal curative effects (further away from its origin), and special curative effects.

2.4 Traditional Theories of acupuncture

Classical acupuncture is based on the acupuncture theories and practices described in the ancient classics of Chinese medicine. Traditional acupuncture theory takes a very different approach and viewpoint than western medicine. Understanding the fundamental

theories of traditional Chinese medicine is essential for understanding the fundamentals of acupuncture. The mechanism of action in acupuncture was understood in traditional Chinese medical theory in terms of the flow of "Qi" and the balance of Yin and Yang through the body's meridians (Hai, 2013).

2.4.1 The concept of “Qi”

“Qi” or “chi” is a multipurpose principle with no modern scientific or biomedical equivalent. It is translated as vital energy or vital force in English. In TCM, Qi is known as the invisible force that controls all of the body's functions, including circulation, respiration, digestion, reproduction, and elimination.

According to Shin (2002), Qi is the energy flow created along the pathways that connect the acupuncture points on the body. The pathways between the points are called meridians, which also connect to internal organs in the body.

Franzblau (2021) quoted that the concept of Qi has two main branches in traditional Chinese medicine. One is the physical or nourishing portion of Qi found in the air, water, and foods we consume. The other is more insignificant, and that is our bodies' vital fluids and energy itself flowing through them.

This vital energy is referred to in Chinese philosophy as the body's innate intelligence, the intangible yet measurable way we maintain homeostasis, or the body's ability to regulate its internal environment to create good health (Friedlander, 2019). According to Wang et al. (2020), our lives is based on Qi, and illness is caused by Qi blockages, Qi deficiencies, and Qi excess (He et al., 2019).

Chinese traditional medicine works on the construct that when the body is sick, the Qi is out of balance and the flow of vital energy must be restored to a healthy flow. When illness leads to an unbalanced, obstructed, and irregular flow of Qi, acupuncture can help.

2.4.2 Principles of Yin and Yang

Yin and Yang are the important principles of Chinese philosophy and medicine. The principles believe that there is a continuum of energy that flows in the body between two opposite poles called the Yin and the Yang (Johnson, 2010). The concept of Yin and Yang serves as the foundation for understanding health as well as diagnosing and treating illnesses in Traditional Chinese Medicine (TCM).

According to Cartwright (2018), good health is believed to come from a balance of Yin (negative, dark, and feminine) and Yang (positive, bright, and masculine). The Yin and Yang are interdependent and interchangeable. Each organ in the body contains a Yin and Yang element.

A disturbance in the balance of the Yin and the Yang in the body results in illness (Yan, 2018). An excess of Yin would damage the Yang Qi, resulting in the development of a cold disease. Likewise, an excess of Yang will damage Yin Qi, resulting in the development of heart disease.

Understanding the body's relative Yin-Yang structure is critical for diagnosing and treating musculoskeletal issues like injuries, chronic pain, and degenerative diseases. For example, shoulder pain can be due to an excess of Yang, where the joint is very stiff, difficult to move, and perhaps inflamed, whereas shoulder pain that is more tense and weak is due to a deficiency of Yin.

Traditional Chinese medicine practitioners attempt to determine the exact nature of the imbalance and then correct it through a variety of approaches, including acupuncture (Lin & Casio, 2015). Acupuncture is based on the theory that harmoniously flowing Qi is the foundation of good health, and it focuses on restoring Qi through manipulation of the

complementary and opposing elements of Yin and Yang (Vanderploeg, 2009). Acupuncture at the appropriate meridians and acupuncture points may help to balance the Yin and Yang. The person's health will improve as the body's balance is restored.

2.4.3 The theory of the five elements

The theory, also known as the law of the five elements, is widely used in traditional Chinese medicine. The theory is likely the earliest documented evidence correlating physiology with disease pathogenesis, and it serves as a guideline for disease treatment.

The Ancient Chinese observed that, just as these essential energetic qualities can be found in nature, they can also be found in all living beings. They could discover and treat the root of a person's illness by understanding the relationships between the elements within and using them as a guide, restoring health to the body, mind, and spirit. Early observations of nature's predictable patterns suggested the existence of an underlying, cyclical flow of energy. Figure 9 illustrates the concept of five elements.

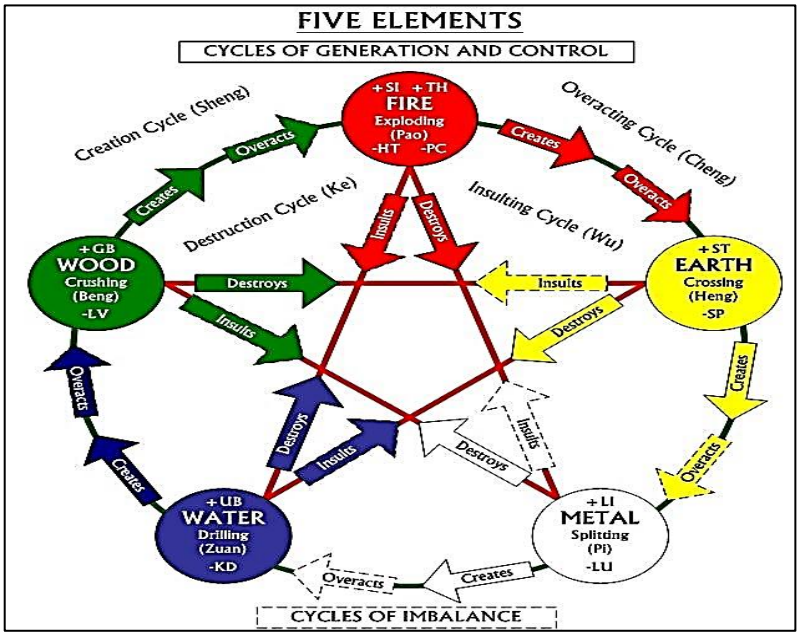


Figure 9: The concept of five elements

The five-element acupuncture tradition is founded on an understanding of the cyclical flow of vital energy, also known as Qi. Each of the five elements—wood, fire, earth, metal, and water—represents a distinct quality of Qi energy, which is essential to nature's ongoing health and flow. Acupuncture practitioners use the law of the five elements to correct energy imbalances in the body, leading to a longer-lasting level of well-being.

2.4.4 The theory of Zang-Fu

The Zang Fu Organ Theory of Chinese medicine is central to disease treatment and diagnosis. Importantly, this theory works in sequence with other fundamental theories of Chinese medicine, such as the Meridian and Yin-Yang theories, to explain the phenomena in the body under normal and disease conditions (Liao, Dang, & Pan, 2017). In Chinese terminology, the term "Zang-fu" refers not only to anatomical entities of internal organs, but also to a generalization of the functions of the human body (Matos, Machado, Monteiro, & Greten, 2021).

TCM divides the internal organs into two groups, which are typically coupled in Yin-Yang. Zang, or solid organs, refers to the five "Yin" organs (heart, spleen, lung, kidney, and liver). Their primary function is to produce and store Qi, xue (blood), Jinye (body fluids), Jing (essence), and shen (spirit). While fu, or hollow organs, refers to six "Yang" organs (small intestine, gall bladder, stomach, large intestine, urinary bladder, and *sanjiao*) [Liao et al., 2017].

Their primary function as a group is to expel waste while simultaneously transmitting and digesting nutrients without storing them. Each of the five Zang-fu organ

systems consists of one Zang organ and one fu organ. The Zang-fu organs, along with other vital components such as Qi and blood, comprise the body and its vitality.

The root cause of disease can be determined by observing and analyzing the external signs manifested by Zang-fu organs.

Because of their interconnectedness (via Qi and blood), Zang-fu organs can affect each other and cause a variety of symptoms in the body. Furthermore, organ concepts in Chinese medicine encompass more than just anatomy (structure) and physiology (function); they also include pathology (disease).

A Chinese medicine practitioner can assess the pathology of an organ based on its external signs and symptoms. Acupuncture, for example, can be used to treat such diseases by restoring the Yin and Yang energies of organs.

2.4.5 The theory of Jing Lou

The traditional Chinese medicine channel system is referred to as Jing Lou. It is also known as meridian-collateral or acupuncture meridians (Chrisman & Xie, 2013). Jing-Luo is a collective term for the pathway through which the body's energy, or Qi, circulates.

The pathways through which Qi (vital energy or vital force) and blood circulate are known as meridians (Jing) and collaterals (Luo). They form a specific network that communicates with the internal organs and limbs, as well as connecting the upper and lower and exterior portions of the body. Jing Luo are the body's primary channels of communication and energy distribution. The meridians are the system's major channels that run lengthwise through the body's interior. The collaterals are the branches of the

meridians, and they run crosswise from the meridians either on or just below the body's surface.

Since they are distributed over the entire body, the meridians and collaterals link together the Zang-fu (organs) and the orifices of the body, the skin, muscles, and bones. They integrate the body into an organic whole in order to carry out systematic activities.

If disease starts in the meridians, the physician can use the meridians to treat the root cause of disease. According to Jing Luo's theory, the channels (meridians) can be manipulated at specific points (called acupoints) using needles (acupuncture), pressure (acupressure), and moxibustion (heat and herbal material burned) to stimulate or calm the connected organs and areas, resulting in balance and harmony of the system.

2.5 TCM view of musculoskeletal shoulder pain

Health, according to TCM theory, is dependent on the free flow of Qi (life force energy) and blood throughout the body (Leong, Wong, & Chen, 2015). Pain is caused by blockages that cause stagnation, which occurs when Qi and blood become stuck (Zhang & Liu, 2022). This can occur as a result of an injury, but it can also be caused by "external pathogenic" factors such as Wind, Heat, Cold, Dryness and Dampness (Ling, 2022). Long term exposure to excessive Wind, Cold and Damp can lead to stagnation of Qi and blood in the meridians of the shoulders. Overtime, when cold and dampness accumulate in the shoulder area, they obstruct the flow of blood, causing shoulder pain.

In Chinese medicine, MSP is classified as a "Bi Syndrome," which is a painful obstruction syndrome caused by external pathogens. (Dashtdar, 2016). One of the primary symptoms of *Bi* syndrome is joint pain, also known as arthralgia. Zhang (2010) clarified

that the term *Bi* syndrome refers to a syndrome characterized by an obstruction of Qi and blood in the meridians caused by the invasion of external pathogenic wind, cold, and dampness, manifesting as soreness, pain, numbness, heavy sensation, swelling of joints and limbs, and limitation of movements.

According to Zhang (2010), *Bi* syndrome can be caused by either external or internal factors. External factors are caused by pathogenic wind, cold, and dampness invading the muscles, joints, and meridians, whereas internal factors are caused by general body weakness as well as defensive Qi. As a result, TCM considers MSP to be a symptom of a larger problem. The diagnosis and treatment of MSP are dependent on the TCM differentiation of shoulder pain as external pathogenic or internal pathogenic.

The Chinese medicine diagnosis of MSP is based on clinical manifestations, such as the nature of the shoulder pain in the shoulder region and its accompanying signs and symptoms. MSP has historically been classified as a painful obstruction syndrome in Chinese medicine. MSP symptoms can be found in a variety of clinical conditions described in Chinese medicine classic literature, including "Bi syndrome" (Bi Zheng), "leakage shoulder wind" (Lou Jian Feng), and "frozen shoulder" (Dong Jie Jian). Table 1 lists the external pathogenic factors and symptoms associated with MSP.

Table 1: External pathogenic factors and symptoms of MSP.

External Pathogenic	Symptoms of shoulder pain
Wind-Cold	Acute shoulder pain that may move around and get worse with cold weather
Cold-Damp	Shoulder feels heavy and swollen, worse in rainy weather, helped by heating pad
Damp-Phlegm	Shoulder muscles feel sore and heavy, hard to move
Qi Stagnation	Sensation of numbness, shoulder is aggravated by stress and emotions
Blood Stagnation	Chronic, stabbing pain, gets worse at night

The etiology and pathogenesis of MSP are well explained in traditional Chinese medicine. There are a few recorded causes and symptoms of MSP in ancient Chinese medicine, such as:

If there is free flow, there is no pain; if there is no free flow, there is pain; If the arms are left uncovered by blankets when one falls asleep, they will be invaded by pathogenic Cold which will lead to pain in the shoulder and arms. "When women feed their babies during the lactation period, the pathogenic Wind and Cold will cause shoulder and arm pain".

According to theories, MSP is caused by a weakness in the defensive Qi, which allows pathogenic Wind, Cold, Dampness, or Heat to infiltrate. When a person spends a long time in a Damp place, wades through water, or is caught in abnormal weather changes (rain or winter), the evil pathogenic Wind, Cold, and Dampness may invade the muscles and joint meridians, obstructing Qi and blood in that area. Wind-Cold-Dampness Bi syndrome will result as a consequence of this.

When the body is invaded by Wind-Dampness-Dampness, or Heat accumulates from excess Yang Qi or deficient Yin and hyperactive Yang, or Wind-Cold-Dampness transforms into Heat. The Heat spreads along the meridians to the joints, causing a number of Heat signs and resulting in what is known as Heat type Bi syndrome (Dashdtar, 2016). The combination of Wind-Cold-Damp *Bi* and Heat *BI* will create symptoms like: pain with no fixed location; pain with a fixed location; soreness pain, heavy sensation, and numbness; and swelling, burning, soreness in the joint at the affected shoulder.

Further research shows that these evil pathogenic factors have a direct impact on internal organs (Zhong, 2010). Pathogens may linger in the meridians and tissues, including bone, tendon, blood vessels, muscle, and skin, because the Five Zang Organs (Liao, Dang, & Pan, 2017) are externally connected with their corresponding meridians and tissues.

For example, bone *Bi* can develop into kidney *Bi*; tendon *Bi* can develop into liver *Bi*; blood vessel *Bi* can develop into heart *Bi* (clinically, this is the most common); muscle *Bi* can develop into spleen *Bi*; skin *Bi* can develop into lung *Bi*, and so on.

2.6 TCM management for musculoskeletal shoulder pain

Based on an etiology, pathogeneses, and diagnosis in Chinese medicine, MSP is classified as the *Bi* syndrome. In *Bi* syndromes, Wind, Cold and Dampness factors usually combine together. During the diagnosis and treatment, it is important to differentiate its type by checking which one is the predominant factor.

It is important to be noted that there are four major types of Bi syndromes, mostly seen in clinic practice: (1) Moving or Wandering Bi (Xing Bi) predominated by wind factor; (2) Painful Bi (Tong Bi) predominated by cold factor; (3) Dampness *Bi* (Zhuo *Bi*) predominated by dampness factor; and (4) Heat *Bi* (Re *Bi*) predominated by heat factor (Zhang, 2010).

It is critical to distinguish between the types of *Bi* syndrome during diagnosis and treatment by determining which factor is dominant. TCM employs syndrome differentiation as a diagnostic and treatment method (Liu, Leong & Tian, 2011).

It is crucial to the therapeutic process and has an impact on the therapeutic outcome of certain diseases or disorders.

In the TCM system, the most commonly used modalities for treating shoulder pain are acupuncture, moxibustion, and Chinese herbal medicine (Luo et al., 2020). Chinese herbal medicine is mainly plant based, but some preparations include minerals or animal products (An & Suo, 2004). Specific herbs are used to dispel Wind and Cold, clear Dampness and Phlegm, and promote blood and Qi circulation.

Acupuncture has been used to treat shoulder pain for over 5000 years, and because it is safer than medical treatments and has fewer side effects, it is now used to treat many types of diseases in modern medicine, specifically chronic joint pain (Guerra de Hoyos et al., 2004).

2.7 TCM acupuncture for musculoskeletal shoulder pain

Acupuncture is a healing modality used in TCM. It focuses on restoring the proper flow of Qi along the body's meridians, regardless of the condition being treated (Marshall, 2020). The fundamental pathology of Bi syndrome is the obstruction of Qi and blood in the meridians caused by pathogenic factors such as Wind, Cold, and Dampness.

According to TCM theory, there will be no pain if the meridians are open and the Qi and blood are flowing smoothly and normally. The basic treatment principles of *Bi* syndrome for MSP are to eliminate pathogenic factors, clear any obstruction of Qi and blood by soothing the meridians, and, most importantly, to relieve pain and clear heat when necessary.

Therefore, using these fundamental theories, acupuncture at specific acupoints is thought to be able to eliminate these pathogenic factors as well as relieve pain and restore shoulder function. The following is a summary of the indications for specific *Bi* syndromes, treatment principles, and MSP acupuncture treatment according to TCM.

2.7.1 Moving or Wandering Bi (Xing Bi)

Wandering *Bi* or Wind *Bi* (wandering arthralgia) is a wind predominant *Bi.* Aversion to the wind, white or greasy fur, and a floating pulse are all symptoms of wandering arthralgia, which has no fixed location. Refer to Table 2.

Table 2: Summary of indication, treatment principal and acupuncture treatment points for Wind *Bi*

Indications	Treatment principal	Acupuncture treatment points
Joint pain in all the limbs. Pain travels from joint to joint or from one location to another, followed by stiffness or limited joint movement. Some wind heat or wind cold symptoms, such as fever and aversion to wind or cold, may occur. The tongue coating looks white, thin, or greasy, and is associated with a floating pulse.	Dispel wind and promote circulation by removing obstruction, Cold-Dampness factors and relieve pain.	LI 4 (Hegu): Energize Qi, eliminate stagnation and dispels Wind. SP 10 (Xuehai): Energize and activate Blood GV14 (Dazhui): Dispels Heat and eliminate Wind, energize Yang, Qi-Blood BL 17 (Geshu): Influential point of Blood, energize and activate Blood GB 20 (Fengchi): Dispels Wind and clears Heat Local points or ashi points: Move local Qi and resolve stagnation and pain

2.7.2 Painful *Bi* (Tong *Bi*)

The most common Bi is painful or cold bi (painful arthralgia). Refer to Table 3

Table 3: Summary of indication, treatment principal and acupuncture treatment points for c**old *Bi***

Indications	Treatment principal	Acupuncture treatment points
Painful joints, pain is fixed, and aggravated by cold. Limited activities of joints. There is no red, swollen, or hot sensation in the painful areas. White thin tongue coating, wiry and tight pulse.	Eliminate cold and relieve the pain, dispel cold and damp factors	CV 4 (Guanyuan): Dispels Cold and Dampness, restores Yang GV 4 (Mingmen): Warm Yang and eliminate Cold BL 12 (Fengmen): Dispels external Wind, regulate Qi GV 14 (Dazhui): Dispels Heat and eliminate Wind, invigorate Yang, Qi-Blood GV 20 (Bai-hui): Warm Yang and strengthen kidney BL 23 (Shenshu): Warm Yang and eliminate Cold Combined with local points or ashi points: Move local Qi and resolve stagnation and pain

Cold Bi syndrome is characterized by severe stabbing arthralgia with a fixed location and a local cold sensation that is relieved by warmth and made worse by cold, white fur, and a rapid heartbeat.

2.7.3 Dampness *Bi* (Zhuo *Bi*)

Dampness *Bi* (fixed arthralgia) is damp predominant *Bi*. Dampness *Bi* syndrome symptoms include white and greasy fur, a soft and slow pulse, and soreness and fixed pain in the joints with localized swelling and numbness. Refer to Table 4.

Table 4: Summary of indication, treatment principal and acupuncture treatment points for Dampness *Bi*

Indications	Treatment principal	Acupuncture treatment points
Painful joints. Heavy or swollen, fixed pain area. Heaviness of four limbs, limited activities. Numbness of skin and muscle. White and greasy tongue coating, thready and slow pulse or cold.	Eliminate dampness and promote the circulation of channels and collaterals, dispel wind and cold factors at the same time.	SP-6: Strengthen spleen and resolve Damp SP 9 (Yinlinguan): Strengthen spleen and resolve Damp GV14 (Dazhui): Dispels Heat and eliminate Wind, invigorate Yang, Qi-Blood BL 17 (Geshu): Influential point of blood, invigorate and activate blood BL 20 (Pishu): Dispels Dampness, activate and nourishes the Blood ST 36 (Zusanli): Strengthen spleen and resolve Damp Local points or ashi points: Move local Qi and resolve stagnation and pain

2.7.4 Heat *Bi* (Re *Bi*)

In Heat *Bi* (heat arthralgia) Dampness gives rise to Heat, so Dampness Heat *Bi* will predominate. Heat Bi syndrome is characterized by arthralgia, localized redness, swelling, and burning sensations, along with a fever, thirst, sweating, and greasy yellow fur, as well as a sluggish and rapid heartbeat. Refer to Table 5.

Table 5: Summary of indication, treatment principal and acupuncture treatment points for heat Bi

Indications	Treatment principal	Acupuncture treatment points
Painful joints. Local swollen and redness. Refuse touching, feels better when cold. Pain can move from one place to another. Limited activities, usually multiple joints affected, mostly accompanied with wind heat symptoms, such as fever, aversion to wind, perspiration, thirsty, restlessness, etc. Dry and yellow tongue coating, slippery and rapid pulse.	Clear heat and promote the Qi and blood circulation, dispel wind and eliminate the dampness.	GV-14 (Dazhui): Dispels Heat and eliminate Wind, invigorate Yang, Qi-Blood LI-11(Quchi): Dispels Wind-Heat and resolve swelling LI-4(Hegu): Dispels Wind-Heat ST-44(Neiting): Dispels Heat GB 14 (Yangbai): Dispels Wind, relieves pain. Local points or ashi points: Move local Qi and resolve stagnation and pain

2.8 Location of common acupuncture points for MSP

There are many acupuncture points used in treating musculoskeletal shoulder pain. The common acupuncture points are: CV 12 (Zhongwan), KI 17 (Shangqu), HT 1 (Jiquan), LU 1 Zhongfu), LU 10 (Yuji), GB 21 (Jianjing), LI 1 (ShangYang), LI 4 (Hegu), LI 11 (Quchi), LI 14 (Binao), LI 15 (Jianyu), LI 16 (Jugu), SI 3 (Houxi), SI 9 (Jianheng), SI 10 (Naoshu), SI 11 (Tianzong), SI 19 (Tinggong), TE 5 (Waiguan), TE 14 (Jianliao), TE 15 (Tianliao), PC 6 (Neiguan), BL 20 (Pishu), BL 21 (Feishu), ST 10 (Shuitu), ST 36 (Zusanli), ST 38 (Tiaokou), ST 40 Fenglong), SP 10 (Xuehai), GV 20 (Baihui), and GB 34 (Yanglingquan). Refer to Figure 10 and Figure 11.

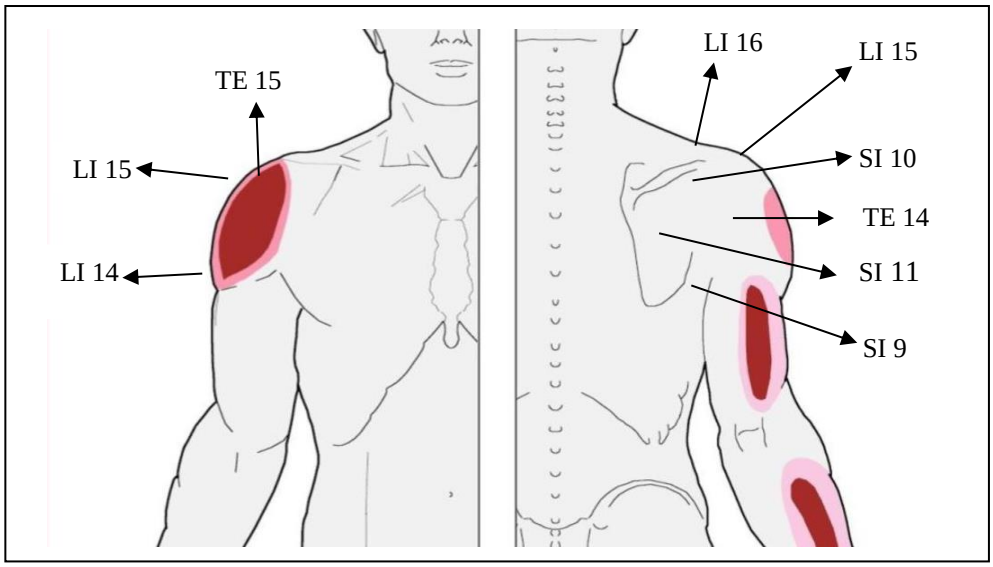


Figure 10: The location of common local acupuncture points for musculoskeletal shoulder pain

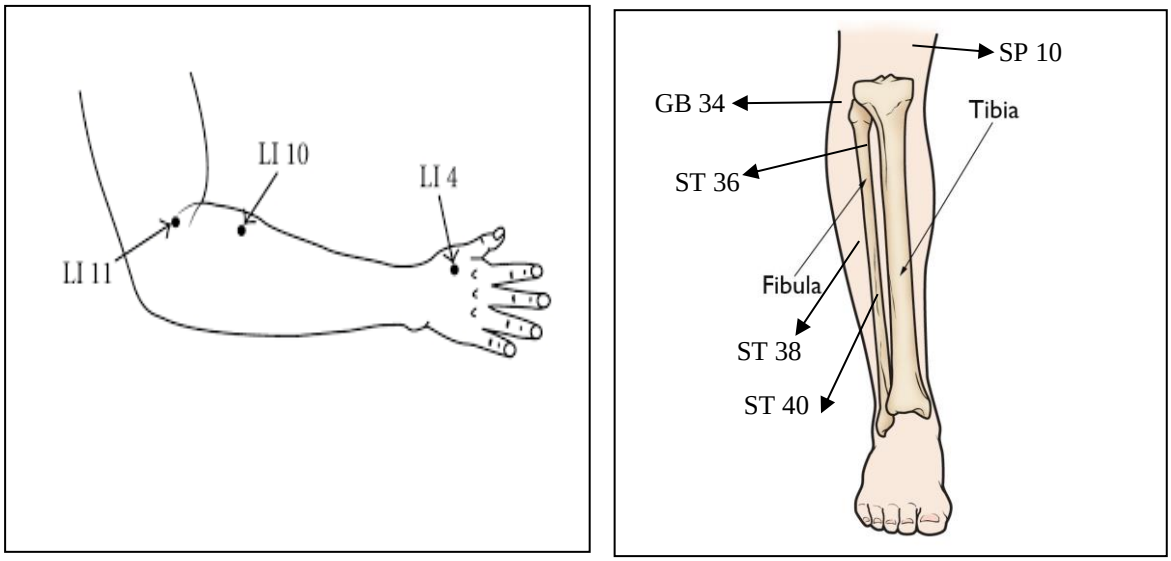


Figure 11: The location of common distal acupuncture points for musculoskeletal shoulder pain

CHAPTER 3.

LITERATURE REVIEW ON ACUPUNCTURE AND WESTERN MEDICINE APPROACHES FOR MUSCULOSKELETAL SHOULDER PAIN MANAGEMANT

There is evidence that acupuncture influences the production and distribution of a great many neurotransmitters and neuromodulators, and that this in turn alters the perception of pain.

This chapter provides a comprehensive literature review of the study from the western medicine approach. It includes the following sections: introduction, anatomy, mechanism, symptoms, causes, risk factors, epidemiology, prevalence, impact, diagnosis, current conventional intervention, assessments methods, complementary and alternative therapies, modern acupuncture theories, western acupuncture, scientific evidence, safety, and existing reviews.

3.1 Introduction to MSP

Any pain in or around the shoulder joint is referred to as “shoulder pain.” These musculoskeletal disorders can be caused by the shoulder joint itself or by any of the numerous surrounding muscles, ligaments, or tendons (Pagan, 2020). The rotator cuff is a group of four muscles and tendons that give the shoulder its range of motion while maintaining the stability of the glenohumeral joint (Maruvada, Madrazo-Ibarra, & Varacallo, 2021). The shoulder joint is designed in such a way that stability is sacrificed for mobility. Any swelling, damage, or bone changes around the rotator cuff can cause significant shoulder pain and disability with a decreased range of motion and use of the

shoulder joint (Wedro, 2020). Shoulder pain caused by a joint typically worsens with activity or movement of the shoulder (Cluett, 2020).

Shoulder pain is most commonly felt in the front of the shoulder or at the top of the arm. The pain is often only felt when you move your arm in a particular way. These conditions are typically long-lasting and chronic (Meislin et al., 2005; Burbank, Stevenson, Czarnechi, & Dorfman, 2008; Pushparaj et al., 2021).

Pain at the shoulder is a common symptom of a variety of shoulder joint disorders, including acromioclavicular (AC) diseases, adhesive capsulitis, biceps tendinitis, glenohumeral arthritis, infraspinatus tendinitis, myotenositis of the long head of biceps brachii, rotator cuff tendinopathy, rotator cuff tears, scapulohumeral periarthritis, shoulder impingement syndrome, subacromial and subdeltoid bursitis, osteoarthritis, and supraspinatus tendinitis (Allen, 2018; Pietrangelo, 2019; Cluett, 2022). Common functional limitations or disabilities caused by MSP include: pain that interferes with sleep, particularly when rolling onto the involved shoulder; Badii (2017) noted that there was pain with rising and falling; overhead reaching, pushing, or pulling; difficulty lifting loads; inability to sustain repetitive shoulder activities (such as reaching, lifting, throwing, pushing, pulling, or swinging the arm); and difficulty dressing, particularly putting a shirt on over the head.

While it may appear that shoulder pain is caused by the shoulder, this is not always the case. Shoulder pain in the general shoulder area, which is frequently difficult to pinpoint, is called referred shoulder pain (Watson, 2019). Referred shoulder pain usually doesn't worsen when moving the shoulder (Pagan, 2020).

Referred shoulder pain may be caused by abdominal problems, such as gallstones or pancreatitis; pelvic problems, such as a ruptured ovarian cyst; heart or blood vessel

problems in which pain is more often felt in the left arm and shoulder, such as heart attack or inflammation around the heart (pericarditis); lung problems, such as pneumonia, where pain may be felt throughout the shoulder, shoulder blade area, upper chest, upper arm, neck, and armpit. Pain is usually felt in the shoulder on the same side as the lung problem. In rare cases, bleeding from the liver or spleen may cause shoulder pain (Dee, Kao, Hong, Chou, & Lew, 2012; Pagan, 2020; Watson, 2019). Other conditions that may be present include herpes zoster (shingles), Paget's disease, or thoracic outlet syndrome.

Shoulder pain is a common indication for visits to primary care or orthopedic clinics worldwide (Creech & Silver, 2021). MSP has a significant impact on people's health and quality of life (Imagama et al., 2020) as well as their social and economic activities (Virta, Joranger, and Brox, 2012; Palmer, Harris, Linaker et al., 2012). Shoulder pain is also common among the working population, resulting in lost productivity, high economic costs, and extended absences (Bodin, 2018).

3.2 Basic Shoulder Anatomy.

The shoulder joint, also known as the glenohumeral joint, is a ball-and-socket joint in the human body with the greatest range of motion. The omnidirectional shoulder is the most mobile and versatile joint in the human body (Miniato, Anand, & Varacallo, 2021). The shoulder muscles have a wide range of functions, including abduction, adduction, flexion, extension, and internal and external rotation.

The shoulder's design allows the arm to rotate 360° from any position relative to its connection to the shoulder. The inherent flexibility and range of motion present in the shoulder are due to the joint's unique structure. The cost of such versatility is an increased risk of injury (Quillen, Wuchner, & Hatch, 2004). Of all the joints that propel human limbs,

the shoulder has the highest risk of soft tissue injury (Feijen, Tate, Kuppens, & Struyf, 2020). Shoulder movement and injuries are frequently described in terms of the shoulder joint, as if the structure only had a single point of flexion, extension, and rotation.

The shoulder is made up of four separate joints (Samper-Escudero et al., 2020), each of which is an integrated device capable of some degree of independent movement. The glenohumeral joint is the largest and most visible of the joints involved in shoulder movement. This is the part of the shoulder that is commonly referred to as the shoulder joint. The glenohumeral structure is formed by the meeting of the humeral head and the glenoid portion of the scapula. These two bones form a "ball and socket" mechanism that allows the shoulder to freely rotate. The glenohumeral joint's flexibility is caused by its own intricate ligament structure as well as the position of the rotator cuff relative to the glenohumeral structure (Yousef et al., 2022). The joint is powered in part by its attachment to the biceps tendon, which connects to the biceps muscle. The rest of the joint's movement is controlled by the rotator cuff's muscles and tendons. Figure 12 depicts the basic anatomy of the shoulder from the anterior and posterior perspectives.

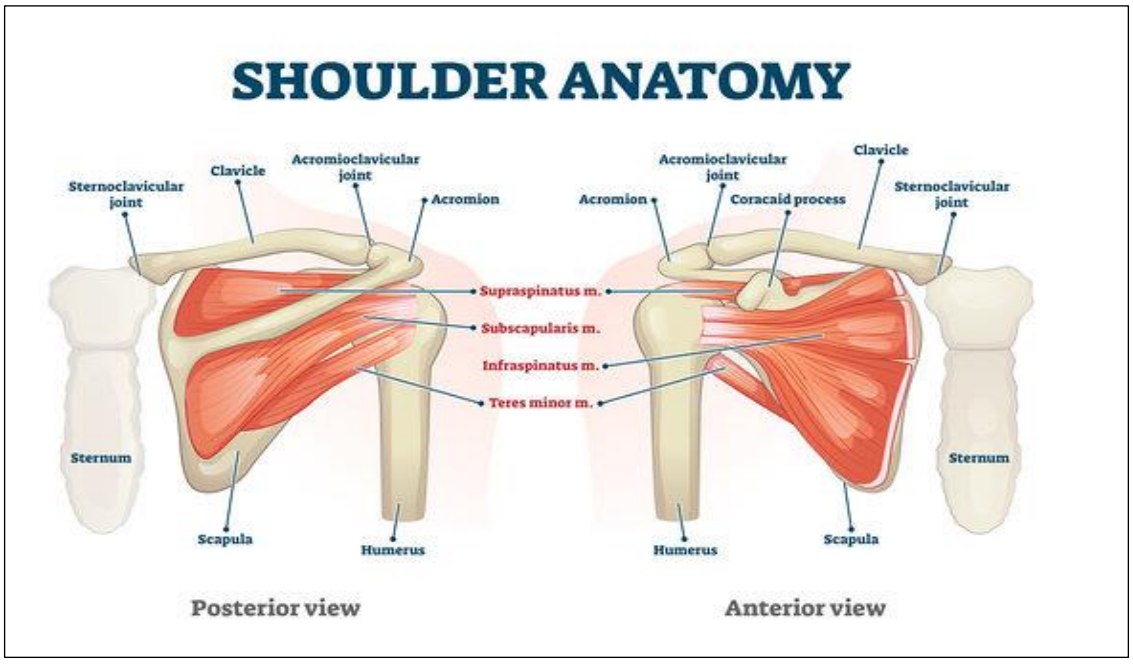


Figure 12: Basic shoulder anatomy

The entire glenohumeral joint is encased in a loose membrane capsule that contains a small amount of synovial fluid, which aids in joint movement. The acromioclavicular (AC) joint is formed by the clavicle and the acromion region of the scapula. When a shoulder is said to be "separated," it refers to the clavicle becoming detached within the AC joint. The AC joint is vulnerable to injury (Crepaz-Eger, 2022). The sternoclavicular joint is formed at the base of the neck at the junction of the sternum and the clavicle. The scapulothoracic articulation is not a joint (Bell et al., 2015) in the technical sense of two or more bones coming together; rather, it is a muscle and tendon mechanism that allows the scapula to slide freely along the upper back as the arm is raised or extended during shoulder movements.

The most important soft tissue structure in the shoulder is the rotator cuff. The rotator cuff muscles are the primary muscle group that supports the shoulder joint. The four rotator cuff muscles include the supraspinatus, infraspinatus, teres minor, and subscapularis (Cowan, Mudreac, & Varacallo, 2021). The rotator cuff, located on the top of the glenohumeral joint, provides muscle power to help the shoulder move, allowing for circular motion (Maruvada, Madrazo-Ibarra, & Varacallo, 2021). When the arm is extended upward, the rotator cuff prevents the joint from becoming overextended. The supraspinatus muscle and its tendon, which extend from the rotator cuff to the top of the humerus, are the most frequently injured of the four rotator cuff tissues (Benazzo, Marullo, & Pietrobono, 2014).

The two bursae, which are located at the highest point of the shoulder, are the two most important soft tissue features of the shoulder. The bursae, which are small fluid-filled sacs made of fibrous material, cushion the joint; the bursa works especially hard to keep the rotator cuff from colliding with the acromion, a bony extension of the scapula.

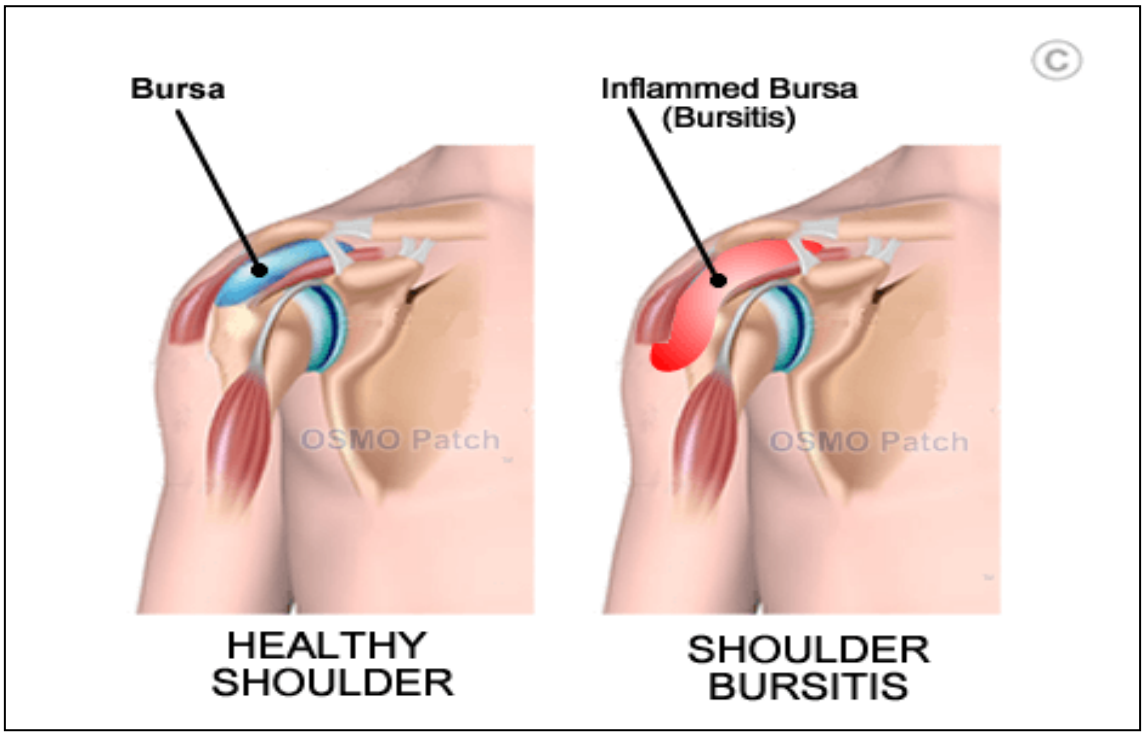


Figure 13. Bursa and Bursitis of the shoulder

Overuse of the shoulder, most commonly through repetitive throwing, will often irritate the bursa fibers (Figure 13), resulting in bursitis, a chronic condition (Faruqi & Rizvi, 2021; Canosa-Carro et al., 2022).

3.3 Different Types of MSP

Pain is a common complaint among patients suffering from a shoulder injury or other shoulder disorders. The type of pain, however, can be influenced by the type of shoulder injury or other shoulder disorders (Haddad, 2016). Each type of shoulder disorder can cause varying degrees and sensations of pain. Shoulder pain is frequently accompanied by other symptoms such as arm weakness, shoulder stiffness, and/or restricted range of motion (Franz, Klose, & Beitzel, 2019). A variety of shoulder disorders cause pain, which

can be described as immediate or severe pain, dull or deep aching pain, radiating pain, or burning pain. This kind of pain may be difficult to pinpoint (Haddad, 2016).

Shoulder injuries that occur as a result of a traumatic event may cause immediate and severe pain. A rotator cuff tear, for example, can cause dull, achy shoulder pain (Asami, 2000). A SLAP tear (superior labrum, anterior to posterior tears) caused by injury or overuse frequently results in a deep, achy shoulder that is difficult to pinpoint (Ireland, & Hatzenbuehler, 2021). A frozen shoulder can cause aching pain around the shoulder and occasionally in the upper arm. Pain is usually more severe in the early stages, but it gradually fades away in the later stages (Chiu, 2021; Pandey & Madi, 2021). Glenohumeral osteoarthritis, or shoulder joint arthritis, can cause deep, achy pain in the joint as well as pain at the back of your shoulder (Zelman, 2020). Arthritis in the acromioclavicular joint, can cause radiating pain in the neck. Overuse is a common cause of acromioclavicular joint arthritis (Geeslin, Fritz, & Millett, 2019).

Rotator cuff tendonitis can cause pain to radiate from the outside of the arm to the topmost part of the shoulder. The condition is caused by overuse of the arm on a regular basis. Some neck injuries, on the other hand, can cause shoulder pain to radiate. A pinched nerve (cervical radiculopathy) and a brachial plexus injury are two examples.

Arthritis in the acromioclavicular joint, at the top of the shoulder, can cause radiating pain in the neck. The common cause of acromioclavicular joint arthritis is overuse (Menge, Boykin, Bushnell, & Byram, 2014; Merrigan, 2022). Rotator cuff tendonitis can result in pain radiating from the outside of the arm near the topmost part of the shoulder (Martel, 2018). This condition is caused by repetitive, overuse of the arm (Varacallo, Bitar, & Mair, 2022). Conversely, some neck injuries can cause radiating pain

into the shoulder. A pinched nerve (cervical radiculopathy) and a brachial plexus injury are two examples (Seladi-Schulman, 2020; Kang, Lee, & Lee, 2020).

3.4 Mechanisms of MSP

A literature review was conducted to create an organized picture of how pain arises and manifests itself, as well as how the mechanisms underlying shoulder injuries and disorders may result in pain. Chronic pain is thought to be caused by neurogenic inflammation, central pain sensitization, excitatory nerve augmentation, inhibitory nerve loss, and/or supraspinal structural dysregulation (Ji, Nackley, Huh, Terrando et al., 2018). Pain mediators such as tachykinins, CGRP, and alarmins, as well as nervous system ion channels, are mentioned as potential research avenues in tendinopathy pain (Raney, Thankam, Dilisio, & Agrawal, 2017).

When patients with shoulder impingement syndrome elevate their arms, they experience the painful entrapment of soft tissue. The pathological mechanism is a structural narrowing of the subacromial space. (Garving, Jakob, Bauer, Nadjar & Brunner, 2017).

The rotator cuff calcific tendinopathy is a common condition caused by calcific deposits in the rotator cuff or the subacromial-subdeltoid bursa when calcification spreads around the tendons. Anyhow, the pathogenesis of rotator cuff calcific tendinopathy is unknown. It appears to be a cell-mediated disease in which the metaplastic transformation of tenocytes into chondrocytes causes calcification within the rotator cuff tendon. (Chianca et al., 2018).

The frozen shoulder has several stages that reflect the sequence of events from capsular inflammation and fibrosis to the spontaneous resolution of this fibrosis. Although

articles on the pathophysiology of frozen shoulder provide inconsistent and inconclusive results, they do suggest that cytokines, growth factors, matrix metalloproteinases, and immune cells are involved in both inflammation and fibrosis. (Cho, Song, Kim, Kim, & Lho, 2018).

Rotator cuff disorders are associated with musculoskeletal problems that affect the joints and muscles of the shoulder, cuff degeneration due to ageing and ischemia, and overloading of the shoulder (Murphy & Carr, 2010). Rotator cuff tendinopathy is caused by factors that encroach on the subacromial space and contribute to bursal side rotator cuff tendon compression. Internal impingement, a unique extrinsic mechanism, is attributed to compression of the posterior articular surface of the tendons between the humeral head and glenoid, resulting in rotator cuff tendon degradation (Seitz, McClure, Finucane, Boardman, & Michener, 2011).

Cervical radiculopathy, also known as "pinched nerve," occurs when a nerve in the neck is compressed or irritated where it branches off the spinal cord. Cervical radiculopathy is a disease process marked by nerve compression from herniated disc material or arthritic bone spurs (Eubanks, 2010). This can result in shoulder and/or arm pain, as well as muscle weakness and numbness. Cervical radiculopathy is frequently caused by aging-related "wear and tear" changes in the spine. It is a multifactorial nerve root injury that can result in significant pain, psychological stress, and disability (Efstathiou, Stefanakis, Savva, & Giakas, 2015).

Cartilage is a smooth, cushiony tissue that covers the ends of bones in a joint. Joints move more smoothly when cartilage is healthy. Cartilage can wear out over time, or it can be damaged as a result of an injury or accident, resulting in the development of

osteoarthritis. Osteoarthritis, the most common form of arthritis, is more commonly found in the acromioclavicular (AC) joint in the shoulder (Zeman, 2020).

Synovitis is a condition that causes swelling and tenderness in the entire shoulder joint. This occurs when the synovial membrane becomes inflamed. Synovitis can be caused by overuse of the shoulder joint, an injury, another condition such as rheumatoid arthritis (inflammatory arthritis), or it can be caused by an unknown cause (Dumain, 2019; Sanchez-Lopez et al., 2022).

In the shoulder, pain caused by an inflamed bursa is also common. A bursa is a small fluid-filled sac that reduces friction between two structures like bones, muscles, or tendons. The subacromial bursa, which sits between the rotator cuff tendon and the bony tip of the shoulder (acromion), can become inflamed in the shoulder, most commonly with repetitive movements. Bursitis can develop as a result of an injury or overuse of the bursae. Swelling that causes pain (excess fluid build-up in a bursa) can occur gradually or suddenly. These conditions are painful and can impair arm mobility (Wheeler, 202; Todd, 2022).

3.5 Symptoms of MSP

There are numerous causes of shoulder pain, each with its own set of symptoms. Depending on the cause of the shoulder pain, patients may experience various symptoms. The common signs and symptoms of MSP include: warmth or redness in the shoulder; neck pain, arm pain, or back pain; a clicking, popping, or grinding sensation when moving the arm; muscle stiffness and weakness; reduced movement or a limited range of motion, inflammation-related symptoms; and swelling. (Hecht, 2019; Shiel Jr., 2019).

The pain in the shoulder is sometimes described as a "catching pain." The pain is felt deep in the shoulder joint, in the back or front of the shoulder blade, and in the upper arm.

The location and type of pain are likely to relate to the structure causing the pain. Depending on the condition, the joint may slip out and back into the joint socket, or the shoulder may become completely dislodged or dislocated (Abrams; & Akbarnia, 2021).

Pins and needles (tingling) sensations and burning pain are more likely to be caused by nerves in the neck than by the shoulder joint itself (Subach, 2016).

Both complete rotator cuff tears and axillary nerve injuries cause weakness in moving the arm away from the body (Wadehra, 2019). These issues necessitate a thorough clinical examination.

3. 6 Causes of MSP

There are many causes of MSP, and not all of them are due to problems with the shoulder joints or associated structures. It may be caused by injuries, overuse, disease, or stem from problems in other parts of your body, which is called referred pain (Pathak, 2021). The etiology of shoulder pain is diverse and includes pathology originating from the neck, glenohumeral joint, acromioclavicular joint, rotator cuff, and other soft tissues around the shoulder girdle (Murphy & Carr, 2010).

The main common causes are related to shoulder fractures, bursitis (joint inflammation), cervical radiculopathy, dislocated shoulder, sprains, torn cartilage, frozen shoulder, osteoarthritis (disease causing the breakdown of joints), rheumatoid arthritis

(inflammatory joint disease), rotator cuff injury, tendinitis, tendon rupture, and impingement (Grauhan, Niehues, Gaudin et al., 2022; Santy, Esparza & Riquenme, 2022).

The less common causes of MSP are cancer, infection, heart attack, thoracic outlet syndrome, septic arthritis (infection), avascular necrosis (death of bone tissue due to limited blood flow), diabetes, gallstones, nerve-related problems, and polymyalgia rheumatica (Villines, 2019; Eske, 2021; Bailey, Cardenas, & Holcomb, 2017; Sambandam, & Atturu, 2016).

3.7 Risk factors for MSP

A number of risk factors have been identified as having an impact on the prevalence of MSP, including socio-demographic, personal, clinical, occupational, educational, and psychological factors (Hecke, Torrance & Smith, 2013). Risk factors for shoulder pain disorders share many similarities with other musculoskeletal conditions.

3.7.1 Socio-demographic risk factor

Older age and female gender contribute as socio-demographic risk factors. MSP is a common and sometimes underestimated cause of pain and disability in elderly people. The prevalence of shoulder disorders in the elderly community is 21%. It is more common in women than in men (Hermoso & Calvo, 2009). The peak prevalence of shoulder pain occurs in people aged 45–64 (Luime et al., 2004).

Soft tissue lesions are the most common cause of shoulder pain in the elderly, including rotator cuff tendinitis or rupture, subacromial impingement, frozen shoulder, and acromioclavicular joint osteoarthritis. Another common cause of shoulder problems in the elderly is fractures of the proximal humerus. Around 85% occurs in people older than 50,

and the incidence peaks in the 60-90-year-old age-group with a female-male ratio of 70:30 (Court-Brown & Caesar, 2006).

3.7.2 Personal risk factors

Personal risk factors include obesity and cigarette smoking. Several studies have found a link between shoulder disorders and metabolic factors such as obesity (Gaida, Ashe, Bass & Cook, 2009; Viikari-Juntura et al., 2008).

According to new research, obese people have a higher risk of certain shoulder injuries than non-obese people. Obese people, in particular, are more likely to suffer from rotator cuff tendinitis or require rotator cuff surgery (Macchi et al., 2020).

Scientists believe this is due to the extra weight that obese people carry in their arms and upper back, which puts too much strain on the shoulder structures. Furthermore, the extra weight may be impairing the blood supply to the shoulder, limiting nutrition and weakening muscles.

For women, there was a significant association between BMI and an increased risk of body injury. Chasse, Fergusson, and Chen (2014) found that women with a higher BMI had a significantly higher risk of body injuries than those with a normal weight.

Cigarette smoking could be a major risk factor for rotator cuff disease (Baumgarten et al., 2010). Smoking has been linked to a number of risks, including the acceleration of RTC, shoulder dysfunction, shoulder symptoms, and an increase in the prevalence of larger RTC tears.

These correlations suggest that smoking may increase the risk of symptomatic RTC.

3.7.3 Medical risk factors

Diabetes and stroke both contribute to what is known as a "medical or clinical risk factor." Shoulder disorders are more common in diabetics than in patients with other medical conditions (Thomas et al., 2007). The two most common shoulder disorders seen in diabetics are frozen shoulder and rotator cuff disease (Alqurashi, Aljabri, and Bokhari, 2011). According to Ricci, Castellarin, Vecchini, and Sembenini (2004), the incidence of frozen shoulder in diabetic patients is 10–36% higher than in non-diabetic patients.

Patients with diabetes are more likely to develop frozen shoulders because uncontrolled blood sugar levels can affect collagen, a major protein found in connective tissue (Rodeo et al., 1997). Sana'a, MacDermid, Overend, and Faber (2019) said that the pathological process could be explained by increased glycosylation of collagen fibers in the joint capsule, tendons, and ligaments, as well as diabetic microangiopathy.

Hemiplegic shoulder pain (HSP) is one of the four most common medical complications after a stroke, with an incidence ranging from 30 to 60% depending on the population studied and the method of assessment used (Adey-Wakeling et al., 2015; Adey-Wakeling et al., 2016). McLean (2004) emphasized that shoulder pain following a stroke has been linked to a variety of medical conditions, including paralysis, limited range of motion in the shoulder, spasticity, a right hemispheric cerebral vascular lesion, left hemiplegia, sensory abnormalities, and so on.

3.7.4 Psychological risk factors

Psychological risk factors include emotional distress and somatization. Currently, some evidence suggests that psychological factors may be related to the prognosis of CSP (Reilingh et al., 2008). Other findings revealed that recurring shoulder pain was linked to

high levels of emotional distress, depressive symptoms, anxiety, preoperative concerns, fear-avoidance beliefs, somatization and pain catastrophizing were significantly associated with high levels of pain intensity and disability (Martinez-Calderon, Struyf, Meeus, Morales-Ascencio, et al., 2017). According to Aguera-Ortiz et al. (2011), approximately 60% of patients with depression report pain symptoms at the time of diagnosis.

3.7.5 Occupational risk factor

Activities such as working with arms raised above shoulder height, working in awkward postures, repetitive work, vibration exposure, and a psychosocial work environment all contribute to occupational risk factors (Rodriguez Diez-Caballero et al., 2020).

In patients with shoulder pain, higher levels of fear of movement and emotional distress were found to be significantly associated with higher levels of disability over a year (Major et al., 2022). The prevalence of shoulder pain across a wide range of occupations has been found to range from 4 to 42%.

According to the findings of Diez-Caballero, Alfonso-Beltrán, Bautista, and Barrios (2020), both ergonomic and psychosocial factors were present and increased the risk of workers (automotive manufacturing sector) developing occupational chronic tendinopathies at the shoulder.

3.8 Epidemiology of Shoulder Pain

Shoulder pain, particularly chronic shoulder pain, has high health-care costs and a significant impact on the health of those affected, including absence from work and disability (Virta et al., 2012). Shoulder complaints have a poor prognosis, with only about

half of all new episodes of shoulder complaints presented in medical practice showed complete recovery within 6 months. After a year, this proportion increases to 60%. The majority of the data on the prevalence of shoulder pain comes from population-based research. (Pribicevic, 2012).

Studies have shown a correlation between shoulder pain and some correlated factors, such as being a woman, performing manual movements above the shoulder level, using vibrating tools, sitting in a position with cervical spine flexion, working standing, performing hard and repetitive physical work, and using a computer on a daily basis (Yue, Liu, and Li, 2012; Takasawa et al., 2015; Greving et al., 2012).

3.9 Prevalence of MSP in general population.

The shoulder complex is highly flexible, capable of lifting heavy loads, and functional in several planes of movement. Unsurprisingly, shoulder pain is common in the general population, and there are multiple potential causes (Appendix 3).

Shoulder pain is a difficult area to study because there are so many different measures used in reporting rates. But, according to a number of studies, shoulder pain is a common complaint, with point prevalence and lifetime estimates as high as 26 and 67 percent, respectively (Luime et al., 2004). Shoulder pain is still prevalent in workers over 50 as the popularity of physically demanding occupations continues to grow.

There is a growing body of evidence to suggest that shoulder disorders may be increased among some workers, particularly those with jobs involving combinations of exposure to overhead work, heavy loads, vibration, forceful work, and repetition (Linaker & Walker-Bone, 2015).

According to the findings from a systematic review, shoulder pain remains common in older people who are still working, especially if their jobs are physically demanding or requiring them to use their upper limbs. (Hodgetts, Leboeuf-Yde, Beynon, et al., 2021).

Shoulder pain seems to affect a large number of patients. Shoulder pain is a common and disabling complaint, according to Cadogan et al. (2011). The reported annual incidence of shoulder pain in primary care is 14.7 per 1000 patients per year (van der Windt et al., 1995), with a lifetime prevalence of up to 70%. (Luime et al., 2004).

The prevalence of shoulder pain ranges from 6.7 percent to 26% in the majority of countries (Australia, Cuba, Finland, the United States, Norway, the Netherlands, and the United Kingdom). In Japan, the prevalence of chronic musculoskeletal pain was 15.4%. The prevalence of shoulder pain in Hong Kong is high, at 30.6%, which is consistent with other studies.

In Pakistan, the prevalence of shoulder pain is estimated to be 30.3% (Addela Mumtaz et al., 2018). In Saudi Arabia, it was around 20.6 percent (Abdulmonem et al., 2014). It was 48.7% in China. (Yue, Liu, and Li, 2012).

The prevalence of shoulder pain in Botswana was 52.5%, which is very high compared to other countries (Erick & Smith, 2014). In general, women seem to be particularly at risk, with a higher prevalence of upper limb and shoulder MSDs than men (Greving et al., 2012).

In contrast to age-related studies, a recent study of chronic pain prevalence (regardless of location) in children and adolescents (ages birth to 18 years) discovered that

prevalence increased with age, peaking in the 12–15-year-old group, with 33% of adolescents reporting chronic pain (Perquin et al., 2000).

3.10 Prevalence of various types of shoulder disorders

The most common causes of shoulder pain in primary care are reported to be rotator cuff disorders, acromioclavicular joint (ACJ) disease, and glenohumeral joint (GHJ) disorders (Mitchell, Adebajo, Hay, & Carr, 2005). The estimated prevalence of shoulder complaints ranges from 7% to 34%, with shoulder impingement syndrome being the most common underlying cause (Nazari, MacDermi, Bryant, & Athwal, 2019).

Shoulder impingement syndrome, first described in 1852, is thought to be the most common cause of shoulder pain, accounting for 44% to 66% of all shoulder complaints (Consigliere, Haddo, Levy, & Sforza, 2018). Rotator cuff tendinopathy has an annual prevalence of 0.5 to 7.4 percent and an incidence of 0.3 to 5.5 percent (Littlewood, May, & Walters, 2013).

Adhesive capsulitis can occur in up to 5% of cases (Kingston, Curry, Galvin, and Li, 2018; Murakami et al., 2018). According to the literature, the prevalence of frozen shoulder (FS) ranges from 2 to 5% worldwide (Hsu, Anakwenze, Warrender, & Abboud, 2011). Diabetes and thyroid gland pathologies, particularly hypothyroidism, may increase the prevalence by 10 to 38 percent, according to Kelley, Mcclure, and Leggin (2009). The majority of people who develop FS are between the ages of 40 and 60. (Kingston, Curry, Galvin, & Li, 2018).

Frozen shoulder is thought to affect 3–5% of the general population and up to 20% of diabetics, according to S.P. Brun (2019). The average age is 56, and women are slightly more likely than men to have the condition.

Rotator cuff problems account for 65-70% of cases of shoulder pain (Speed, 2006). Osteoarthritis (OA) is the world's most common joint disease, and there is currently no cure. Glenohumeral osteoarthritis (GHOA) accounts for an estimated 5%–17% of patients with shoulder complaints (Ibounig, Simon, Launonen, & Paavola, 2020). Subacromial pain accounts for up to 70% of all shoulder-pain problems (Mitchell, Adebajo, Hay, & Carr 2005).

3.11 Impact of MSP on quality of life and economy

Kemp, B. J., Bateham, A. L., and Mulroy (2011) pointed out that painful shoulders pose a substantial socioeconomic burden. Notably, shoulder pain may complicate or interfere with a person's daily activities, social events, and overall quality of life (QOL**).**

Research shows that shoulder complaints impact both physical and mental QOL. Recent research indicated that the severity of shoulder pain was an independent risk factor for poor physical QOL (Imagama, et al., 2020).

Shoulder pain disorder symptoms can be persistent and disabling in terms of an individual's ability to carry out daily activities both at home and in the workplace (Kuijpers et al., 2004). As a result, the vast majority of patients with shoulder pain disorders are treated in primary care (Boykin, Heuer, Vaishnav, & Millett, 2010)**.**

Shoulder pain is a common cause of lost work days and disability (Pribicevic, 2012). People with a disabling shoulder disease are expected to lose 1.8 to 8.1 years of working life, depending on their age, when compared to the general population (Siren, Viikari-Juntura, Arokoski, & Solovieva, 2019).

Aside from disabilities, there are significant economic costs associated with increased health-care demands, impaired work performance, significant sickness absence, and early retirement or job loss (Palmer et al., 2012).

3.12 Diagnosis of MSP

Shoulder pain is a commonly reported ailment. According to population surveys, shoulder pain affects 18–26% of adults at any point in time (Walker-Bone et al., 2004). Because there are numerous potential causes of shoulder pain, a thorough review of symptoms, a physical examination, and, in some cases, imaging tests are required as part of a proper diagnosis procedure.

When a diagnosis is accurate and made in a timely manner, a patient has the best opportunity for a positive health outcome because clinical decision-making will be tailored to a correct understanding of the patient's health problem (Holmboe and Durning, 2014). Diagnosis has important implications for patient care, research, and policy.

3.12.1 Physical examination

A chronic MSP patient may experience symptoms such as pain deep in the shoulder joint, reduced movement and pain, shoulder or upper arm weakness, pins and needles (tingling), burning pain, or a lack of shoulder function (Iftikhar, 2019; Bodor, Uribe, & Srikumaran, 2021). PETS (physical examination tests of the shoulder) are clinical examination maneuvers that are used to aid in the diagnosis of shoulder complaints (Gismervik, Drogset, J.O., Granviken, F. et al., 2017). A physical exam can aid in the confirmation or exclusion of a diagnosis of shoulder disease or any other disorder (Malanga, 2018).

To obtain important diagnostic clues, the physical examination of shoulder pain begins with taking a history, inspecting, palpating, assessing ROM, performing muscle strength tests, and performing physical examination tests (Yang, Kim, Kim, & Chang, 2021).

In conducting the physical test for MSP, Woodward et al. (2000) suggested that the neck and elbow be examined as well to rule out the possibility that the shoulder pain is referred from a pathologic condition in either of these areas. Some basic tests, such as range of motion and muscle strength, will most likely be performed first. Specific shoulder tests are then used to narrow down the possible causes and most effective treatments. The Neer's test (orthopedic examination of the shoulder) is one of the specific tests for shoulder pain. It is used to look for a type of rotator cuff injury called impingement, which is common in young and middle-aged people (Sears, 2022).

The Speed test is another specific test used to diagnose biceps tendonitis (Chen et al., 2016). A few studies indicated that a modified form of Neer's test has a 90.6 percent accuracy rate for identifying subacromial impingement syndrome (Guosheng et al., 2017; Chongxi et al., 2017; GuoQing et al., 2017; Junling et al., 2017). In summary, the most sensitive diagnostic tests for subacromial impingement syndrome (SIS) were found to be the Hawkins test (92.1%), the Neer test (88.7%), and the horizontal adduction test (82.0%). Tests with the highest specificity were the drop arm test (97.2%), the Yergason test (86.1%), and the painful arc test (80.5%), consecutively (Caliş et al., 2000).

3.12.2 Laboratory Test

Laboratory tests are often helpful in determining the cause of musculoskeletal disorders (Cherney, 2018). A blood test will be performed to detect rheumatoid factor or

anti-cyclic citrullinated peptide (anti-CCP) antibodies (in cases of rheumatoid arthritis). When there is inflammation, the ESR level usually rises (Tishkowski & Gupta, 2021), especially in the case of periarthritis of the shoulder. Therefore, a blood test will be performed as well to determine the erythrocyte sedimentation rate (ESR). A blood test will also be performed to determine the level of the creatine kinase enzyme present in the blood (Scripko, Amato, & Puig, 2014).

In conditions such as rheumatoid arthritis and polymyalgia rheumatica, laboratory tests are useful in diagnosing, preparing for treatment, and monitoring treatment progress (Villa-Forte, 2020).

3.12.3 Imaging

Diagnostic imaging, particularly ultrasound-guided injections, can be a valuable resource for shoulder conditions as an aid to clinical diagnosis, injury management rehabilitation, and, finally, treatment accuracy (Crowell, Dedekam, Johnson et al., 2016).

Researchers have suggested the increase in use of diagnostic imaging, including x-ray, diagnostic ultrasound, and magnetic resonance imaging (MRI) for shoulder pathology is possibly related to the challenges in classification of shoulder pain and low levels of practitioner confidence in making an accurate clinical diagnosis, specifically a pathoanatomic diagnosis (Cadogan, McNair, Laslett, & Hing, 2016).

3.12.3.1 X-rays (Radiography)

X-rays can aid in the diagnosis of certain shoulder conditions. It can detect dislocations, subluxations, associated fractures, cartilage damage, and deformities in the context of traumatic injuries or the unstable shoulder (Baudi, Rebuzzi, Matino, & Catani,

2017). X-rays can also be used to detect the presence of certain infections, the presence and severity of glenohumeral arthritis, the presence and severity of AC arthritis or rheumatoid arthritis, and to differentiate glenohumeral arthritis from adhesive capsulitis (Lee, 2020). Figure 14 show a sample of X-ray of a patient with osteoarthritis (degenerative joint disease) of the shoulder.

Figure 14: AP X-ray of a patient with osteoarthritis (degenerative joint disease) of the shoulder.

3.12.3.2 Ultrasonography

Ultrasonography (USG) is increasingly being used to detect inflammation in and around joints, as well as tears or inflammation of tendons (Kaeley, Bakewell, & Deodhar, 2020). Armstrong, Teefey et al. (2006) discovered that, when compared to arthroscopy, ultrasonography performs well in the diagnosis of dislocation or subluxation of the long head of the biceps (sensitivity 96%, specificity 100%).

Ultrasonography (USG) is also reliable for detecting complete biceps tendon tears, but it may not be adequate for detecting partial tears (sensitivity of 49%, specificity of 97%).

The researchers came to the conclusion that while USG is able to accurately identify a complete rupture, subluxation, or dislocation of the bicep's tendon, it is unable to identify intraarticular partial-thickness tears. Figure 15 illustrated a sample of ultrasound pic of shoulder injury.

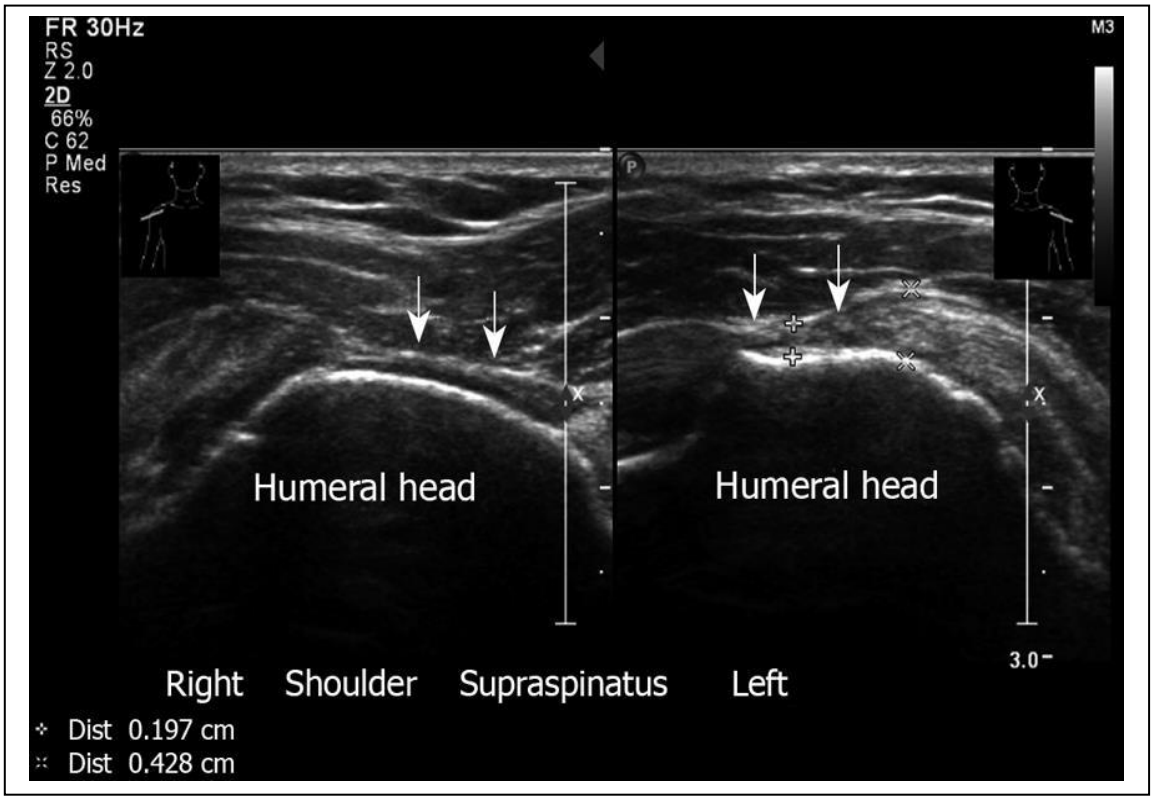


Figure 15: Bilateral shoulder pain due to partial thickness tear of supraspinatus.

In the case of a painful shoulder, Salek et al. (2011) discovered that USG is a more useful modality for evaluation of the shoulder joint than plain X-ray. The USG had a sensitivity of 73.3%, a specificity of 88.2%, a positive predictive value (PPV) of 84.6%, a negative predictive value (NPV) of 78.9%, and an accuracy of 81.3%.

Ultrasonography is operator dependent, but in the hands of a skilled technician, it can be as effective as magnetic resonance imaging (MRI) in detecting full-thickness tears (sensitivity 92%, specificity 94%) and partial-thickness tears (sensitivity 92 percent, specificity 94%) (sensitivity 67.9%, specificity 94%) [Gazzola & Bleakney, 2011].

In terms of cost and comfort, Middelton et al. (2004) found that USG is less expensive than MRI and is better tolerated and preferred by patients.

3.12.3.3 Magnetic resonance imaging and magnetic resonance arthrography.

Magnetic resonance imaging (MRI) and magnetic resonance arthrography (MRA) have become frequently used as diagnostic tools for the evaluation of structural abnormalities in the shoulder. This includes the rotator cuff and the subdeltoid/subacromial bursa and other structural abnormalities (Shahabpour et al., 2008).

Figure 16: A sample of magnetic resonance imaging (MRI) and magnetic resonance arthrography (MRA) of the shoulder injury

Liu, Dong, Shen et al. (2020) discovered that MRA had the highest sensitivity, specificity, and superiority index in detecting full-thickness (FT) tears, partial-thickness (PT) tears, or any tear (Figure 16).

MRI provides a more comprehensive view of the shoulder as a whole and can be useful if a surgical procedure is planned (de Jesus et al., 2009). According to Lenza et al. (2013), MRI, MRA, and US may have comparable accuracy in detecting the presence of full-thickness tears. The researchers concluded that all three imaging tests (MRI, MRA, and US) may aid in surgical referral decisions for people with suspected full-thickness tears based on their findings.

3.13 Current Conventional Intervention for MSP

For patients with MSP, there are conservative and surgical treatment options available in Western medicine. Physical therapy, platelet-rich plasma infusion, NSAIDs, corticosteroid injection, heat therapy, electrotherapy, manual therapy, immobilization, and kinesiology taping are examples of conservative treatments.

Acromioplasty, bursectomy, and arthroscopic subacromial decompression are surgical remedies. Western conservative and surgical treatments for MSP are reportedly effective for short-term pain relief but have limited long-term therapeutic benefits. (Nejati, Ghahremaninia, Naderi, Gharibzadeh, & Mazaherinezhad, 2017).

A wide range of both conventional and surgical interventions are currently used to treat shoulder pain. Moosmayer, Lund, & Seljom (2013) suggest that surgery offers better outcomes than non-operative treatments in some conditions, while others have argued that non-operative interventions produce equivalent outcomes to surgery (Beard, Rees, Cook, & Rombach, 2018).

3.13.1 Non-invasive, nonpharmacological intervention

3.13.1.1 Rest

The shoulder is a very flexible joint that is made up of several tendons, ligaments, and muscles that all work together (Hecht, 2020). Shoulder pain can result from injuries, general wear and tear, and a number of inflammatory conditions. Resting the joint is an important step in treating most shoulder pain (Barrell, 2019).

Basically, shoulder pain, stiffness, or weakness can make it difficult to carry out everyday tasks. Hence, there are ways to treat temporary shoulder pain at home. For general shoulder pain,

Iftikhar (2018) suggested resting or changing the activity that may have caused the shoulder pain. Cluett (2022) also suggested that resting the joint and allowing the inflammation or irritation to subside is the first line of treatment for many common types of shoulder pain.

For a shoulder injury, the National Institute of Arthritis and Musculoskeletal and Skin Diseases Trusted Source recommends the RICE approach: (1) Rest the shoulder for 48 hours, (2) **Ice** the shoulder for 20 minutes four to eight times per day, (3) Compress the shoulder using a wrap or a bandage, and (4) Elevate the shoulder above the chest level (Zambon, 2020). Slings are often used to keep an injured shoulder in place.

Total rest or stopping all shoulder movements due to pain can quickly lead to joint stiffness (Cluett, 2022). Slings are often used to keep an injured shoulder in place (Cicetti, 2013). After rest, stretching and exercise can improve the range of motion, strengthen muscles, and prevent injury.

3.13.1.2 Exercise

In MSP patients, the primary goals of exercise are to reduce symptoms and improve joint functional performance (Hunter & Eckstein, 2009). According to a growing body of research, therapeutic exercise is widely used in the treatment and management of a variety of shoulder disorders (Littlewood et al., 2012).

In a recent study, Dominguez-Romero et al. (2021) discovered that physical exercise programs focused solely on muscle development were effective in the treatment of rotator cuff tendinopathy with the goal of improving shoulder pain and function. However, an earlier study by Bennell et al. (2010) showed that a standardized program of manual therapy and home exercise did not provide any additional immediate benefits for pain and function when compared to a realistic placebo treatment.

According to research in sports, exercise therapy has been shown to reduce the incidence of shoulder pain, manage shoulder pain, and improve shoulder musculoskeletal risk factors in competitive swimmers (Yoma, Herrington, and Mackenzie, 2022).

Steuri et al. (2017) studied the efficacy of conservative interventions, including exercise, in adults with shoulder impingement and discovered that exercise was superior to non-exercise control interventions for pain and that specific exercises were superior to generic exercises.

In other research, Desmeules et al. (2016) found that there is low-to-moderate-grade evidence that therapeutic exercises are an effective modality for shoulder impingement in adults in terms of pain reduction, improvement in function, and return to work.

3.13.1.3 Physiotherapy

Physiotherapy is a multimodal pain management approach that may include exercise, manual therapy, and pain-reduction techniques (Chester, Shepstone, Daniell, Sweeting, et al., 2013). Electrotherapy modalities such as transcutaneous electrical nerve stimulation (TENS), interferential current, thermotherapy, cryotherapy, and ultrasound may also be included (Watson, 2000).

Physiotherapy is often the first line of management for shoulder pain, and to date, its efficacy has not been established (Green, Buchbinder, & Hetrick, 2003). Earlier reports indicate that up to one third of patients referred to physiotherapy musculoskeletal outpatient services have shoulder pain (May, 2003).

Rotator cuff disorders are a common musculoskeletal pain presentation in the general population, and physiotherapy is frequently prescribed. (Pieters, Voogt, Bury, Littlewood, et al., 2019). Physiotherapy is one of the most common conservative treatments for frozen shoulders (Wong & Tan, 2010). Physical therapy has been shown to relieve pain and restore functional motion in painful shoulder impingement syndrome (Chan, Pua, & How, 2017).

A one-year follow-up study on the effectiveness of physiotherapy and costs in patients with clinical signs of shoulder impingement syndrome (Kromer, de Bie, & Bastiaenen, 2014) shows that there is no difference in the improvement of shoulder impingement syndrome between the manual physiotherapy group and the individualized exercises group. The only significant difference was the cost, which was in favor of the individualized exercise group. According to Karel et al. (2017), patients with shoulder pain in physiotherapy practice frequently show signs of subacromial impingement syndrome. After 12 weeks, 41% of the patients still received physiotherapy treatment. The search for

the effectiveness of physiotherapy for MSP still continues (Gomora-Garca et al., 2016). However, there is still limited high-level evidence to prove the therapeutic effectiveness of physiotherapy for shoulder pain (Favejee et al., 2011; Klintberg et al., 2015).

3.13.1.4 Rehabilitation

According to WHO (2021), rehabilitation is defined as *"a set of interventions designed to optimize functioning and reduce disability in individuals with health conditions in their interaction with their environment."* The aim is to ensure long-term results in joint mobility, reduce stiffness, and improve shoulder function (Michener, Walsworth, & Burnet, 2004).

Basically, rehabilitation is care that can help people get back, keep, or improve the abilities that they need for daily life. These abilities may be physical, mental, and/or cognitive (thinking and learning).

Painful shoulder impingement syndrome is one of the main reasons for medical care in the general population and is one of the principal reasons for consulting rehabilitation services (Gomora-Garca et al., 2016).

The number of trials evaluating the efficacy of physical rehabilitation interventions for patients with shoulder pain remains limited, and the quality of those that are available is moderate (Sauers, 2005).

3.13.1.5 Patient education

Education plays a great role in the management of individuals with shoulder pain (Edwards et al., 2016). Patient education is essential in reducing frustration and encouraging compliance in people with MSP, particularly those with frozen shoulders.

It is important to emphasize that, while full range of motion may never be restored, the condition will spontaneously resolve and stiffness will significantly decrease over time.

Santello et al. (2020) discovered that teaching patients with shoulder pain how to do home-based exercises improved their shoulder function while decreasing pain intensity and medication intake. Other researchers discovered that the pain level among patients with rotator cuff-related pain decreased after they underwent a pain education session. The researchers concluded that after the pain education session, the participants had a better understanding of the factors influencing their shoulder pain (Sole et al., 2020).

3.13.2 Pharmacological intervention

Pharmacological treatment is the use of medication to treat a disorder or disease. Shoulder pain, for example, has been treated with a variety of agents administered in a variety of ways. Pharmacological treatments include oral agents such as acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), opioids, corticosteroids, and antidepressants (Al-Mohrej et al., 2022). In the short-term period, intra-articular corticosteroid intervention, either alone or after shoulder capsule distension, provided clinically meaningful improvements.

Likewise, rotator-interval corticosteroid injections yielded promising results in terms of pain relief. However, these short-term benefits of steroids disappear gradually over time. Multiple-site corticosteroid injections showed a clinical advantage over placebo for short-and intermediate-term composite outcome assessments (Kitridis et al., 2019).

Although oral NSAIDs may be effective in the short term period in people with acute tendonitis or subacromial bursitis, it is not known for sure that topical NSAIDs, oral corticosteroids, oral paracetamol, or opioid analgesics improve shoulder pain.

3.13.2.1 Anti-inflammatories

Nonsteroidal anti-inflammatory drugs (NSAIDs) relieve pain and reduce inflammation. Inflammation reduction is critical for rotator cuff injuries, tendonitis, arthritis, and other shoulder injuries (Iftikhar, 2018). However, side effects such as pain, a vasovagal reaction, changes in serum glucose levels, and facial flushing may prevent patients from receiving this treatment (Sun et al., 2015).

Zheng et al. (2014) suggest that NSAIDs are less effective than corticosteroids in achieving remission in patients with shoulder pain 4–6 weeks after treatment. Boudreault et al. (2014) conclude that oral anti-inflammatory drugs are as effective as corticosteroid injections in treating short-term pain but not for shoulder function.

3.13.2.2 Oral steroid and steroid injections

Steroid injections, also called corticosteroid injections, contain a powerful anti-inflammatory drug called cortisone (Lee, 2019). Cortisone may be injected around the affected tendons to reduce inflammation and swelling that may be causing or contributing to the impingement. Previous studies have reported that intraarticular steroid injection is a useful treatment option for primary FS in the outpatient department (Kim, Lee, Lee, & Choi, 2017). According to Zelman (2021), steroid injections are one of the most effective ways to reduce pain and improve function, but they do not cure the illness.

Earlier research shows that oral steroids such as prednisolone or cortisone may work to treat shoulder pain in the short term. It may decrease pain and disability and may improve movement in the shoulder in the short term (may not last 6 weeks). But there is not enough evidence to be certain of the benefits and harms of oral steroids, and more research is needed (Buchbinder, Green, Youd, & Johnston, 2006). But in a recent study,

Atici, Ermutlu, Akesen, and Ozyalçin (2021) claimed that high-dose oral prednisolone treatment (1 mg/kg/day) provides rapid improvement of symptoms, and these improvements persist long after discontinuation of the drug.

However, according to Cluett (2022), shoulder pain patients should not be recommended to receive more than 2 to 3 rounds of corticosteroid injections because repeated administration may result in tissue weakening, tendon damage, and infection can occur in the treated area.

3.13.2.3 Nerve blocks

Strenuous physical activity and repetitive movement can cause damage to the shoulder bones, cartilage, and tendons. The soft tissues and cartilage that surround the shoulder can deteriorate with age (Cluett, 2022). A lack of cartilage can cause pain because the bone ends rub together. A shoulder that was once flexible can become tender and painful. Shanahan, Smith, Wetherall, and colleagues (2004) proposed that nerve blocks could help people who have damaged shoulder bones, cartilage, and tendons.

Nerve blocks are used to treat and manage pain (Wheeler, 2022). A nerve block is a local anesthetic and steroid injection into the affected shoulder area. Nerve blocks alleviate pain by preventing pain signals from reaching the brain. It can help alleviate post-surgery pain. Lee, Choi, and Lee (2020) discovered that performing nerve blocks on the articular branches of the suprascapular and subscapular nerves resulted in positive outcomes for shoulder pain patients. They concluded that, regardless of shoulder pathology, this new injection method can be used safely in patients with shoulder pain. Nerve blocks are a safer alternative to opioids. Nerve blocks can lower the risk of

opioiddependence following surgery as well as many opioid side effects such as fatigue, nausea, and sedation (Billesberger, Fisher, Qadri, & Boortz-Marx, 2020).

3.13.3 Surgical treatment options

Mild cases of shoulder pain, regardless of the cause, can often be effectively treated conservatively with options such as rest, physiotherapy, pain relief, and glucocorticoid injections. When other treatment methods have failed, after 3-6 months, surgery may be considered as an effective way to minimize or eliminate shoulder pain (Chaudhury et al., 2010).

Minimally invasive shoulder surgeries such as manipulation under anesthesia and arthroscopic capsular release are commonly used to treat biceps tendon injuries, bone spurs, frozen shoulder, labrum tears, osteoarthritis, rotator cuff tears, rotator cuff tendinitis, and shoulder impingement syndrome (Le, Lee, Nazarian, & Rodriguez, 2017). The advantage of minimally invasive surgery is that it results in shorter recovery times and fewer complications (Jewell, 2018).

3.13.3.1 Manipulation under anesthesia

Some of the MSP cases do not respond to conservative treatments. Manipulation under anesthesia (MUA) is believed to be the most widely used non-conservative treatment option for these refractory cases. MUA is a minimally invasive surgical procedure that aims to relieve chronic pain and reduce stiffness in the joints. The process of frozen shoulder manipulation under anesthesia is illustrated in Figure 17.

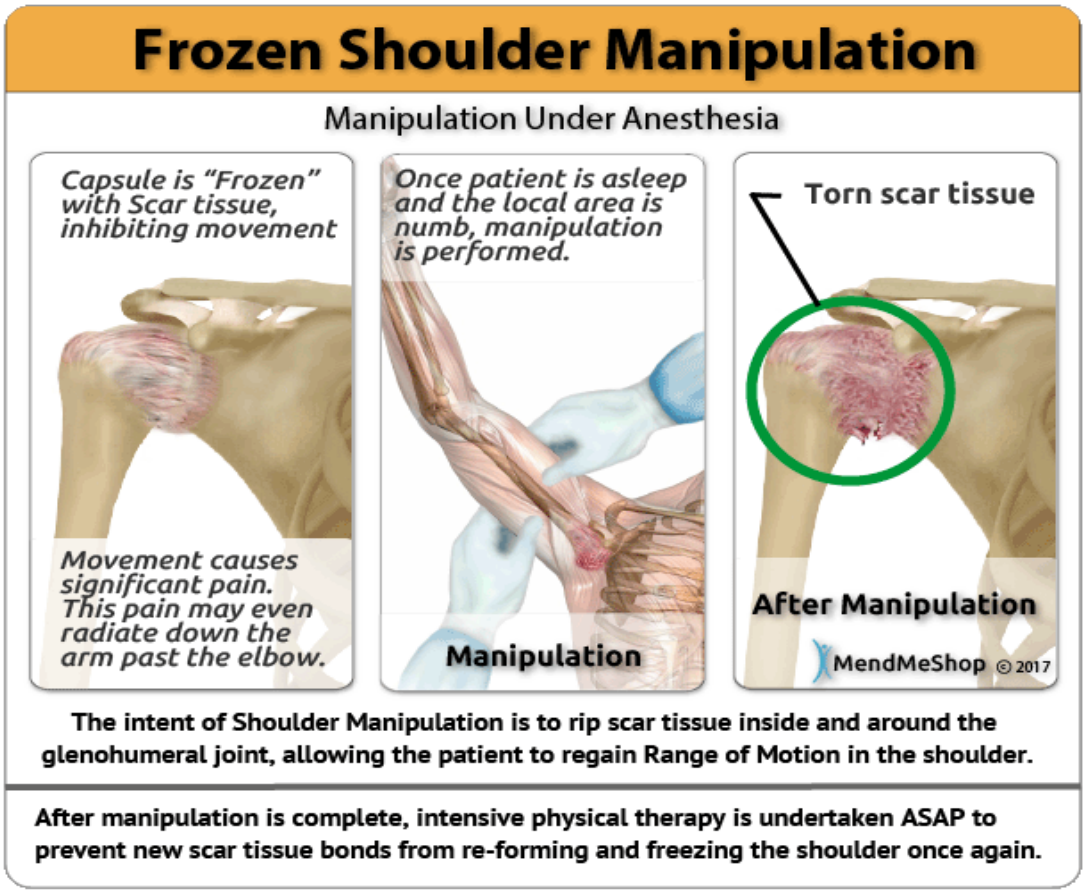


Figure 17: Frozen shoulder manipulation under anesthesia (adapted from aidmyfrozenshoulder.com)

With MUA, the tight shoulder joint capsule is stretched and torn with manipulation. Kraal et al. (2019) discovered that MUA for frozen shoulder (FS) leads to a considerable increase in range of motion and the Oxford shoulder score, with a significant reduction in pain, and around 85% satisfaction.

It is a time-efficient procedure and relatively easy to perform, resulting in rapid restoration of the ROM of the shoulder joint and reducing the symptoms of FS (Dodenhoff, Levy, Wilson, & Copeland, 2000). Although MUA is a useful option for primary FS, research (Magnussen & Taylor, 2011; Loew, Heichel, & Lehner, 2005) warns that it may result in several complications, such as proximal humerus fracture, shoulder dislocation, brachial plexus stretching injury, rotator cuff injury, and glenoid fracture. Despite it being

widely regarded as a safe procedure, D' Orsi, Via, Frizziero, and colleagues (2012) also reported hemarthrosis, capsular tear, labral detachment, SLAP (superior labral anterior and posterior) lesion, and humeral or glenoid fracture following MUA.

3.13.3.2 Arthroscopic capsular release and repair

Arthroscopic capsular release is a keyhole surgery that involves the release of the tight, constricted capsule and, at the same time, helps to improve shoulder range of motion and alleviate shoulder pain caused by adhesive capsulitis (Nihr, 2020). This surgery is performed under general anesthetic and a regional nerve block (Shanahan et al., 2004; Surendran et al., 2020). It involves two main steps: arthroscopic release and manipulation.

It is an effective treatment for most people with stiff shoulders after injury, trauma, or fracture and diabetes (Le et al., 2017).

Patients experienced significant reductions in pain, improvements in range of motion, and improvements in overall shoulder function during the first postoperative week. These immediate pain and function improvements continue to improve six, twelve, and twenty-four weeks after surgery (Levy et al., 2008; Barnes, Lam & Murrell, 2016).

Arthroscopy capsular release (ACR) and manipulation under anesthesia (MUA) can be used to treat primary frozen shoulder. These are both useful for primary FS. Furthermore, MUA can be performed without the surgical equipment required for an arthroscopic procedure. The indications for the two procedures are also identical (Kim et al., 2020; Grant, Schroeder, Miller & Carpenter, 2013). According to Yoo, Koh, Shon, Bae, and Lim (2018), MUA and ACR are effective treatments for primary FS. ACR is less complicated than MUA because no arthroscopic equipment is required. MUA, on the other

hand, can result in a number of serious complications. A sample of arthroscopic capsular release is illustrated in figure 18.

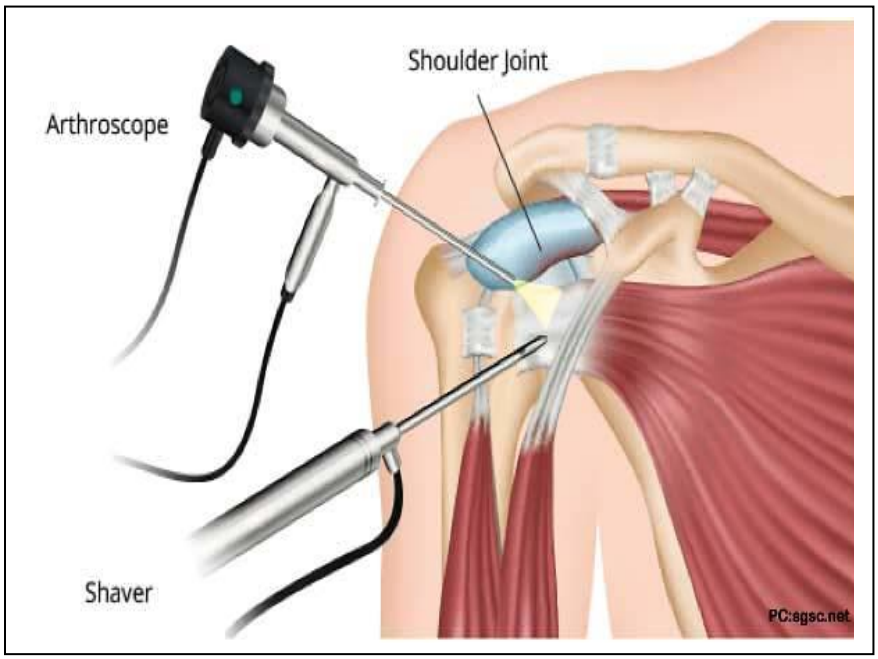


Figure 18: A sample of arthroscopic capsular release (adapted from snibbeorthopedics.com)

3.14 Assessment for MSP

Both clinical trials and effective pain management require valid and reliable pain and functional assessments before and after treatment (Borchgrevink et al., 2008). A number of pain and functional assessment instruments have been used to determine the severity of shoulder pain and the level of shoulder function in people with shoulder pain disorders.

To assess shoulder pain and functionality, the Visual Analog Scale (VAS), Range of Motion (ROM), Shoulder Pain and Disability Index (SPADI), and Constant-Murley Score (CMS) are commonly used instruments.

3.14.1 Shoulder pain-intensity assessment.

The Visual Analog Scale (VAS) is a pain rating scale that is commonly used to assess the intensity of shoulder pain before and after treatment (Boonstra et al., 2008). The VAS is a one-dimensional, self-administered instrument with a straight line of 10 cm (100 mm) in length (Kimura et al., 2008). A sample of VAS is illustrated in Figure 19.

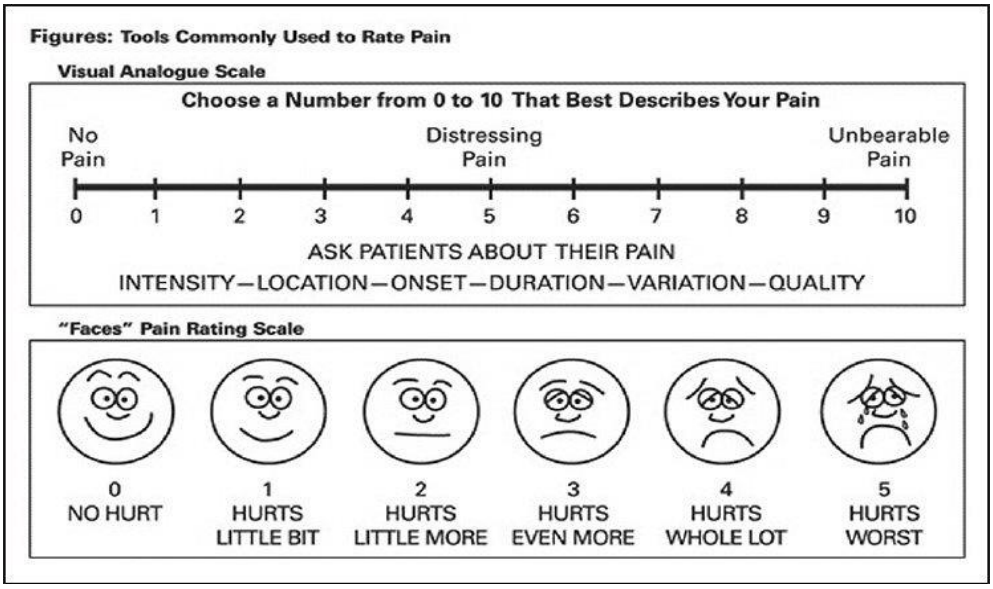


Figure 19: A sample Visual Analog Scale (VAS)

Scores are based on self-reported measures of symptoms, which are recorded with a single handwritten mark placed at one point along the length of a 10-cm line, representing a continuum between the two ends of the scale: "no pain" on the left end (0 cm) of the scale and "severe pain" on the right end (10 cm) of the scale (Delgado et al., 2018). People mark a point between those extremes to show how much pain they are experiencing.

The measurement is in millimeters and is interpreted as follows: 0 to 0.4 cm equals no pain, 0.5 to 4.4 cm equals mild pain, 4.5 to 7.4 cm equals moderate pain, and 7.5 to 10 cm equals severe pain or unbearable pain (Altaim & LeRoux, 2019).

The values can be used to track a patient's pain progression or to compare pain between patients with similar conditions (Delgado et al., 2018). VAS is relatively simple to use, particularly for less educated raters and immigrants (Wewers & Lowe, 1990).

Researchers believe that the VAS has better responsiveness (the ability to detect clinically significant change) and is more reliable and valid than other scales (du Toit et al., 2002). Others claim that VAS appears to assess pain accurately based on what patients actually experience (Ohnhaus & Adler, 1975).

3.14.2 Shoulder range of motion assessment.

The range of motion is the measurement of movement around a specific joint or body part. Motion capacity measurements of the ranges of motion (ROM) of the shoulder joint are critical in the evaluation and diagnosis of MSP. ROM was associated with both pain, functionality, and fear of movement (Ozden et al., 2021). For MSP, ROM is used to calculate the degree of angularity between the moveable arm and the body.

A universal goniometer is a typical instrument used to measure ROM (Gandbhir & Cunha, 2021). It is used to measure angles between the moveable arm and the body of the affected shoulder before and after treatment.

Goniometry is used in physical therapy to determine the total amount of available range of motion at a specific joint. There are two "arms" that are hinged together, one stationary and one movable. Each is placed at specific points on the body, with the goniometer's center aligned with the point of interest. The therapist can precisely measure ROM in degrees by using hash marks on the hinge (Sears, 2020). The ROM of the shoulder

is typically measured in six directions: flexion, extension, abduction, adduction, pronation, and supination. A sample goniometer is illustrated in Figure 20.

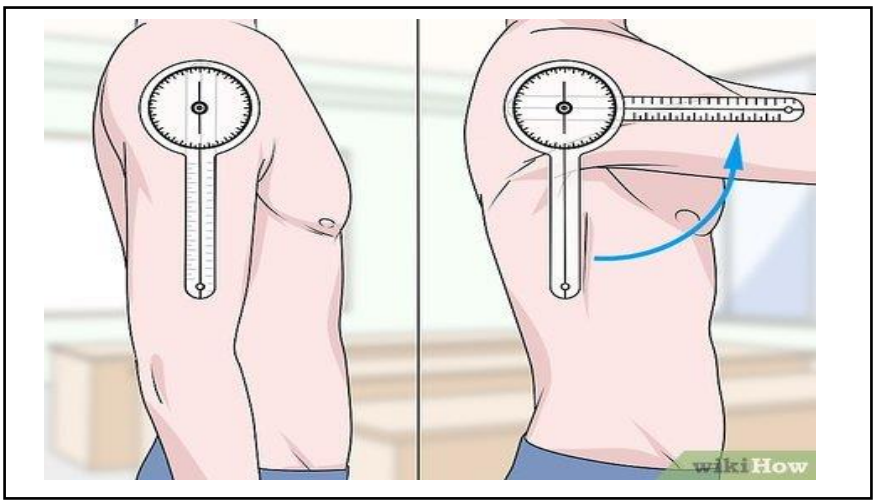


Figure 20: Sample of universal goniometer in use

Goniometry can assess both active and passive ranges of motion. (Norkin & White, 2016) The expected range of motion is 0–180 degrees.

3.14.3 Shoulder Pain and Disability Assessment Index (SPADI)

In clinical and research settings, SPADI is a reliable and valid tool for assessing individuals with shoulder pain and disability (Ho, Ling, & Samihah, 2022). It is one of the most widely used scales of its kind (Tveita, Ekeberg, Juel, & Bautz-Holter, 2008).

The reliability and internal consistency of SPADI were found to be high (Cronbach's alpha > 0.92) [Roy, MacDermid, & Woodhouse, 2009]. The SPADI has good construct validity and correlates well with other regional shoulder questionnaires (Paul, 2004; Bot et al., 2004). It was designed for use in an outpatient setting to assess current shoulder pain and disability (Breckenridge & McAuley, 2011). The Shoulder Pain and

Disability Index (SPADI) is a self-administered questionnaire completed by the patient. It is made up of two dimensions. One for pain and one for functional activities (Roach, BudimanMak, Songsiridej, & Lertratanakul, 1991). Figure 21 displays the SPADI instrument sample.

SPADI (SHOULDER)

Name _____ Date_____

PAIN SCALE												
How severe is your pain:												
1. At its worst.	No pain	0	1	2	3	4	5	6	7	8	9	10 Worst Pain Imaginable
2. When lying on involved side.	No pain	0	1	2	3	4	5	6	7	8	9	10 Worst Pain Imaginable
3. Reaching for something on a high shelf.	No pain	0	1	2	3	4	5	6	7	8	9	10 Worst Pain Imaginable
4. Touching the back of your neck.	No pain	0	1	2	3	4	5	6	7	8	9	10 Worst Pain Imaginable
5. Pushing with the involved arm.	No pain	0	1	2	3	4	5	6	7	8	9	10 Worst Pain Imaginable
DISABILITY SCALE												
How much difficulty did you have:												
1. Washing your hair.	No difficulty	0	1	2	3	4	5	6	7	8	9	10 So difficult required help
2. Washing your back.	No difficulty	0	1	2	3	4	5	6	7	8	9	10 So difficult required help
3. Putting on an undershirt or pullover sweater.	No difficulty	0	1	2	3	4	5	6	7	8	9	10 So difficult required help
4. Putting on a shirt that buttons down the front.	No difficulty	0	1	2	3	4	5	6	7	8	9	10 So difficult required help
5. Putting on your pants.	No difficulty	0	1	2	3	4	5	6	7	8	9	10 So difficult required help
6. Placing an object on a high shelf.	No difficulty	0	1	2	3	4	5	6	7	8	9	10 So difficult required help
7. Carrying a heavy object of 10 pounds.	No difficulty	0	1	2	3	4	5	6	7	8	9	10 So difficult required help
8. Removing something from your back pocket.	No difficulty	0	1	2	3	4	5	6	7	8	9	10 So difficult required help

Figure 21: Sample of shoulder pain and disability index (SPADI).
(Adapted from: Roach et al., 1991)

The pain dimension consists of five questions about the severity of a person's pain. Functional activities are assessed using eight questions designed to assess an individual's level of difficulty with various activities of daily living that require upper extremity use.

The SPADI takes 5 to 10 minutes for a patient to complete and is the only region-specific measure for the shoulder that is reliable and valid.

The patient is asked to select the number that best describes their level of pain and difficulty using the affected shoulder. The pain scale is summed up to a total of 50, while the disability scale sums up to 80. The total SPADI score is expressed as a percentage. A score of 0 indicates the best, and 100 indicates the worst. A higher score shows more disability (Roach et al., 1991). SPADI can be used for the following shoulder pain or shoulder disorders: rotator cuff disease, osteoarthritis, rheumatoid arthritis, frozen shoulder, and shoulder arthroplasty.

3.14.4 Constant-Murley score (CMS)

The Constant-Murley Score (also known as the Constant Score or Constant-Murley Shoulder Outcome Score) is used to evaluate the outcomes of shoulder disorder treatment (refer to Appendix 5). The Constant-Murley score (CMS) is one of the most commonly used scales for shoulder dysfunction (Blonna, Scelsi, Marini, & Bellato, 2012). The Constant-Murley shoulder assessment score has proven to be a valuable diagnostic instrument, and the assessment score gives a more accurate view of the functional result for MSP (Fialka, Oberleiter, Stampfi, & Brannath, 2005). It has the advantages of including a pain score, functional assessment, range of motion, and strength measurements.

The CMS is a 100-point scale made up of several individual parameters. These parameters define the patient's level of pain and ability to perform normal daily living tasks (Ziegler et al., 2019).

The score is made up of four variables that are used to assess the function of the shoulder and are divided into two categories: subjective variables and objective variables. The degree of pain is rated on a scale of 0 to 15, and the ability to perform normal daily tasks is rated on a scale of 0 to 20 points. Furthermore, active motion range is measured on a scale of 0 to 40, and shoulder power is measured on a scale of 0 to 25. The sum of the scores from subjective and objective variables yields the Total Constant Score.

The total score that can be obtained is 100 (Hirschmann et al., 2010; Vrotsou et al., 2018). Both the right and left shoulders are evaluated separately. The advantage of this assessment is that it takes only 5-7 minutes (Angst et al., 2011). Another disadvantage of this assessment is that it is interviewer-administered.

3.14.5 Fugl-Meyer Assessment (FMA)

The Fugl-Meyer Assessment (FMA) is a performance-based impairment index for stroke patients. It is intended to evaluate patients with post-stroke hemiplegia in terms of their motor functioning, sensation, balance, joint range of motion, and joint pain. It is used in clinical settings and research to assess disease severity, describe motor recovery, and plan and evaluate treatment (Fugl-Meyer et al., 1975; Gladstone et al., 2002).

The FMA was developed for use with post-stroke hemiplegic patients of all ages. The scale is divided into five domains, with a total of 155 items. Items in the motor domain assess movement, coordination, and reflex action in the shoulder, elbow, forearm, wrist, hand, hip, knee, and ankle.

Sections of the FMA are frequently administered separately, but the entire FMA takes about 30-35 minutes to administer (Poole & Whitney, 2001).

Direct observation of performance is used to score. Scale items are scored based on their ability to complete the item using a 3-point ordinal scale, where 0 means they cannot perform, 1 means they partially perform, and 2 means they fully perform. The maximum scale score is 226. Refer to Appendix 6.

3.14.6 Kruskal-Wallis test (UCLA Questionnaire)

It is one of the scales for assessing shoulder disorders. The maximum score for this assessment is 35 points. This questionnaire asks questions about the degree of activity, muscle force, and satisfaction with the outcomes, as well as whether the pain is constant or intermittent, whether it requires painkillers, whether it is related to rest or activities, and whether it is related to rest or resting.

3.14.7 The Physician Global Assessment (PGA)

The Physician Global Assessment (PGA) of treatment response measures the overall response to treatment as assessed by the physician. Physicians use PGA as a measurement tool to quantify disease activity (Pascoe et al., 2015). PGA is one of the patient-reported outcomes, whose content is associated with pain, functional limitation, psychological distress, and comorbidities.

The PGA is meant to generally reflect patient's own assessment of severity of the condition and is included in disease activity indices used to guide therapy decisions ((Synder et al., 2017). The PGA is a well-accepted and commonly used scale for evaluating treatment response in clinical trials, both in adults and children. Refer to Appendix 7.

3.15 Complementary and Alternative Therapies for MSP

Many complementary and alternative therapies for MSP have been studied in clinical trials, including traditional Chinese medicine (Chinese herbal medicine, acupuncture, moxibustion, tuina, tai chi, Qi gong, gu asha, cupping therapy), chiropractic, and yoga.

Complementary and alternative therapies have proven to be extremely effective in the treatment of scapulohumeral periarthritis. According to research, complementary and alternative therapies are relatively simple for doctors and patients to use, with few side effects and positive long-term outcomes (Gao et al., 2021).

Acupuncture is thought to be the most effective pain relief treatment among complementary and alternative therapies. According to Abdelkefi et al. (2015), acupuncture is useful and effective for pain relief and improving shoulder function. It can be a good alternative, especially for patients experiencing drug-related side effects.

Acupuncture devices used in modern society are far superior in terms of quality to those used thousands of years ago (Lao, 2007). Kelly and Willis (2019) claimed that acupuncture has been increasingly used as an integrative or complementary therapy for pain. Acupuncture is well-tolerated with a low risk of serious adverse effects.

Wang et al. (2022) found that acupuncture is a widely used complementary and alternative treatment for shoulder pain. Zhang et al. (2017) verified that the therapeutic effects of complementary and alternative treatments are definite. They discovered that acupuncture can stimulate the meridian and acupuncture points to regulate Qi and, at the same time, activate blood stasis to relieve pain.

3.16 Scientific bases of acupuncture

Acupuncture in the modern era is a synthesis of traditional acupuncture and a scientific understanding of the body. It is founded on an understanding of traditional acupuncture concepts as well as the study of human anatomy and physiology. Acupuncture theories of today are based on neurophysiological theories.

To explain the mechanisms of acupuncture, various neural theories have been developed (Karavis, 1997). According to Lund & Lundeberg (2016), acupuncture is a type of sensory stimulation that is evaluated using sensory neural pathways. As a result, from a scientific standpoint, the nervous system and nerve impulses are important factors in understanding acupuncture's role in pain relief, as the autonomic nervous system (ANS) plays an important role in the mechanism of acupuncture.

Several studies have been conducted to investigate the relationship between acupuncture point stimulation and ANS involvement (Beissner, Deichmann, Henke, & Bar, 2012; Noguchi, 2010). The modern theory summarized that sensory nerve impulses, coding patterns, and frequency of the ANS regulate sensation and functions of internal organs. As a result, if any pattern or frequency changes before arriving at the destination, it may indicate changes in sensation.

It is obvious that external stimulation can alter the physical mechanism involved in the nerve impulse. This leads to the conclusion that acupuncture is one of the most important external stimuli for changing neural coding through electrical and thermal intervention (Zhang, Wang, & Mc Alonan, 2012).

Modern acupuncture, also known as medical acupuncture, came out with a few scientific bases for acupuncture theory, such as the neuro-humoral theory, morphogenetic

theory, nerve reflex theory, endorphin theory, and gate control theory related to pain control and pain relief.

3.16.1 Neurohumoral Theory

Neurohumoral is a theory in physiology that explains that the transmission of nerve impulses is due to chemical mechanisms. The biological effects of acupuncture include the regulation of a variety of neurohumoral factors and growth control factors (Shang, 2009). Acupuncture analgesia is mediated by the peripheral nervous system. Acupuncture stimulates the brain cortex and nerve system, which then control chemical or hormone release to the disordered organs via the meridian system. It acts through neurohumoral mechanisms. The analgesic action of acupuncture was demonstrated to be mediated by stimulating the release of natural endorphins in the brain (Han, 2004).

3.16.2 Morphogenetic Theory

To explain the cellular mechanisms in acupuncture that go beyond the neurohumoral theory, the morphogenetic singularity theory was created. According to the morphogenetic singularity theory, the bioelectric field and the meridian system are both involved in the regulation of growth and morphogenesis (Shang, 2000). The surface bioelectric fields contain singular points at acupuncture points.

Acupuncture points have a local maximum in electrical conductance as well as a high density of gap junctions. In other words, compared to their surroundings, they easily permit the most electricity to pass through. They act as a point of convergence for surface current because they have the highest electric current density in the area. It is a single location where the flow of electric current abruptly changes. It denotes a sudden change in from one state to another. Small disturbances around singular points can therefore have

a significant impact on the body. It has been hypothesized that acupuncture might trigger these bio electrochemical oscillations to transmit signals. As a result, the functioning of other physiological systems includes meridian signal transduction. Since many other non-excitable cells have electrochemical oscillations for long-distance intercellular communication, it is hypothesized that acupuncture may activate these oscillations for signal transduction.

3.16.3 Nerve-Reflex Theory

A group of Japanese physiologists created the "nerve-reflex theory" in the 1950s to explain how the autonomic nervous system and the periphery interact reflexively. They showed that there was a connection between the cutaneous surface (skin) and the viscera (organs), connected by these reflexes, the "viscera-cutaneous reflex" and the "cutaneous-viscera reflex." According to them, any abnormalities in the internal organs can cause spasm, referred pain, or redness on the skin's surface. Acupuncture needle stimulation results in an inverse reaction that alters blood and lymph flow and thereby lessens symptoms.

Acupuncture is therefore viewed as a systemic stimulation therapy that stimulates these autonomic reflexes to enable the immune and neuroendocrine systems to help the body restore its homeostatic balance and accelerate the healing process (Ulloa et al, 2017).

3.16.4 Endorphin Theory

Acupuncture has been proven to release endogenous opioids, including endorphins, which have a systemic analgesic effect on the body (Okada & Kawakita, 2009). Acupuncture triggers the release of endorphin into the central nervous system. Corticoids and substance P also released along with endorphin. Acupuncture appears to

initiate a series of events involving the release of endogenous opioid-like substances such as enkephalin, endorphin, and endomorphin, which modulate pain signals processed along the pathway (Wang et al., 2008).

3.16.5 The Gate Control Theory of Pain Relief

This theory, proposed in 1965, explains how acupuncture works through the nervous system to relieve pain (Mandal, 2019). The spinal cord, according to gate control theory, contains a neurological "gate" on the nerve fibers between the peripheral nerves and the brain, and they help control how pain messages flow from the peripheral nervous system to the central nervous system by either blocking or allowing pain signals to continue to the brain (Cherry, 2022). Figure 22 illustrates the mechanism of the gate control theory related to pain relief.

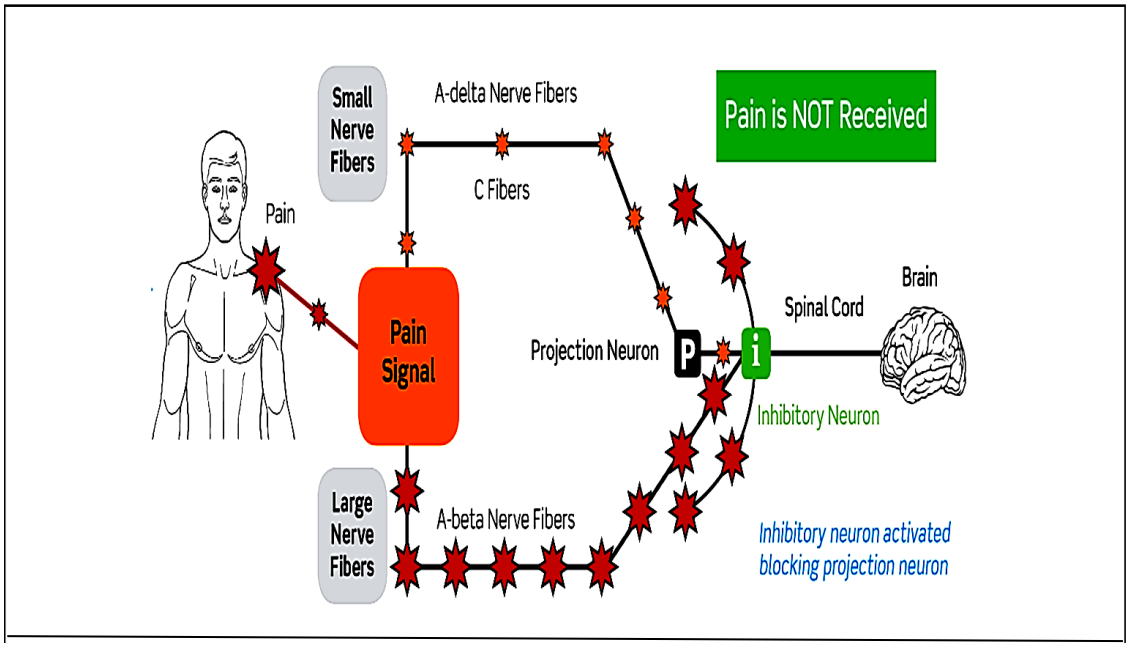


Figure 22: Mechanism of gate control theory

A gate in the spinal cord distinguishes between different fiber types when carrying pain signals. Pain signals that travel through small nerve fibers are allowed to pass, whereas signals that travel through large nerve fibers are blocked (Arle, Mei, Carlson, & Shils, 2016).

In 1980, Man and Chen proposed another theory to explain the effectiveness of acupuncture (Mandal, 2019). This was referred to as the "Two-Gate Control Theory." According to this theory, there are two types of nerve fibers: A-beta and C nerve fibers. The A-beta nerve fibers are large and fast-conducting, with a low volt threshold, whereas the C-beta nerve fibers are small and slow-conducting, with a high volt threshold. Figure 22 illustrates the mechanism of the gate control theory related to pain relief.

According to the theory, when a large number of impulses from A-beta fibers close the gate in the substantia gelatinosa, the passage of painful impulses from C fibers is prevented. Under normal conditions, these pain signals travel freely through the open gates along "fast" A-Delta nerve fibers (which sense sharp pain) and "slow" C nerve fibers (which sense dull pain). The signals are then routed through structures known as projection neurons before reaching the spinal cord and, ultimately, the brain.

The theory further explains that hyper-stimulating A-Beta fibers (which detect touch) in the area experiencing pain can trigger a response from nearby structures known as inhibitory neurons. When inhibitory neurons, which are located on the same pathway as projection neurons, are activated, they can mute pain signals before they reach the spinal cord and brain, effectively dampening the pain (Yam et al., 2018). Therapies that affect the A-Beta nerve fibers, such as massage, acupuncture, and surface nerve stimulation, are thought to act on the nerves in such a way that pain signals are interrupted (Lynch, 2001).

Acupuncture relieves pain by stimulating acupuncture points, which affect A-beta nerve fibers (Cantwell, 2010). The needles move in order to send a steady stream of non-pain impulses to the substantia gelatinosa, causing the gate to close. The pain impulses stop when the gate is closed. As a result, there is no pain. The A-beta fiber impulses can be transmitted to the thalamus, which serves as the final gate. This gate is closed to relieve pain throughout the body.

This neurophysiological pathway could explain why acupuncture is effective for treating both chronic and acute pain (White, Cummings, & Filshie, 2018).

3.17 Western medical acupuncture (WMA)

Since their inception thousands of years ago, the traditional acupuncture mechanisms have remained constant and are based on ideas like meridians, acupuncture points, qi, and yin yang. However, for people who prefer mainstream medicine and contemporary science, it is possible to find a modern interpretation of these concepts that is based on neurobiological and fascial network models.

The main pathways in the body's connective tissue and fascia network are referred as meridian. Because of the concentration of connective tissues and nerve endings along this network, acupuncture stimulation at certain locations tends to produce stronger responses than at other locations.

Due to the greater density of connective tissues and nerve endings, traditional acupuncture points are the locations where stimulation by acupuncture results in a stronger response than nearby sites.

The signals within the channels that mediate the effects of acupuncture are referred to as qi. The movement of paracrine-signaling molecules (Bai et al., 2011) and the transmission of mechanical force are two additional possible signals, though the nerve signal is the one that is best understood (Langevin & Yandow, 2002).

The autonomic nervous system's parasympathetic and sympathetic branches work together to maintain homeostasis, which is referred to as “yin-yang” balance. Western medical acupuncture (WMA) is a modern derivative of traditional acupuncture. It is a therapeutic modality involving the insertion of fine needles. In western medical acupuncture; needling is seen as a form of neuromuscular stimulation (Jabbari et al., 2019). The practice is based on orthodox Western scientific principles. Western medical practitioners have rejected the ideology that served as the foundation of Chinese acupuncture.

Even though WMA evolved from Chinese acupuncture; its practitioners no longer accept concepts like Yin or Yang and the circulation of Qi. They portray acupuncture as a component of conventional modern medicine rather than an alternative medical system. The concept of "same treatment for different diseases" is central to traditional Chinese medicine, but it is not recognized by the WMA.

Baldry and White (2005), concluded that acupuncture works primarily by stimulating the nervous system, with known modes of action including local antidromic axon reflexes, segmental and extra segmental neuromodulation, and other central nervous system effects.

Further studies by Rubens (2021) show that acupuncture works by triggering the release of numerous chemicals in the body, including endorphins, dynorphins, serotonin,

cholecystokinin and oxytocin. It has a wide range of clinical applications, including the treatment of musculoskeletal conditions, women's health problems, functional bladder and bowel problems, and managing the side effects of cancer treatment (Cox, Varatharajan, & Cotec, 2016; Cochrane et al., 2014; Wu et al., 2018; Lu et al., 2008).

Willem ten Rhyne, a Dutch physician who published ‘Dissertatio de Arthritide’ in 1683, was the first European to write a detailed report on Chinese and Japanese medicine (Bivins 2012). Following in this lineage, Felix Mann pioneered the concept of medical acupuncture, viewing acupuncture as a type of peripheral nerve stimulation technique. In this method, needles are inserted into anatomically defined sites and manually or electrically stimulated.

According to the WMA, acupuncture stimulation is more effective in areas rich in specialized sensory receptors (Chen et al., 2014), such as muscle spindles, Golgi tendon organs, ligament receptors, Paciniform and Ruffini's receptors (joint capsules), deep pressure endings (within the muscle belly), and free nerve endings (muscle and fascia). All of these areas are densely innervated, and as a result, there are a variety of physiological responses that aid in the modulation of pain perception.

The insertion of an acupuncture needle is a novel stimulus in Western Medical Acupuncture that works by sending anti-nociceptive input to the neuroimmune system (Zhang et al, 2012).

This contributes to a variety of physiological changes in peripheral and central nervous system areas such as peripheral receptors, the dorsal horn of the spinal cord, the brainstem, sensorimotor cortical areas, and the mesolimbic and prefrontal areas. (Chen et al. 2017, Maeda et al. 2017).

3.18 How does acupuncture help in MSP?

3.18.1 Reduced inflammation

Acupuncture helps in reducing inflammation in the shoulder regions by stimulating the release of immunomodulatory and vascular factors; these are neuropeptides (small proteins produced by specialist nerve cells) that help regulate inflammation, blood vessel control and blood flow in the affected area (Zijlstra et al., 2003; Kavoussi & Ross, 2007; and Kim et al., 2008).

3.18.2 Less pain and modifying the way the body responds to pain.

Acupuncture on specific acupuncture points on the shoulder regions stimulates the nerves located in the muscles and other tissues to release the hormone serotonin and natural pain-killing chemicals called endorphins. These chemical messengers promote relaxation and feelings of wellbeing, and also alter the way the body processes pain in the brain and spinal cord (Cheng, 2009; Zhao, 2008; and Xiang et al., 2017). Refer to Appendix 8.

3.18.3 Decreased shoulder stiffness and improved range of motion and mobility

Acupuncture decreased shoulder stiffness and improved range of motion and mobility by enhancing blood flow to the area. Acupuncture improves local microcirculation by increasing the diameter and blood flow velocity of the veins and arteries that supply the shoulder area. Poor circulation in the shoulder joint and a lack of fluid in the shoulder bursa (the fluid-filled sacks in between joints to reduce friction) contribute to pain and inflammation. Stronger circulation of blood in the shoulder area improves nutrient delivery, educes pain sensation, enables the shoulder to move more freely without feeling pain (Ben-Arie et al., 2020; and Komori et al., 2009).

3.19 Recent scientific evidence of the mechanism of acupuncture's effect

3.19.1 Acupuncture and opioids

Previous studies have suggested that acupuncture-induced analgesia is mediated by the release of endogenous opioids (Goa et al., 2015). Acupuncture-induced effects interact with and coordinate different levels of the central nervous system (CNS). It is considered to be a complicated process (Li et al., 2019).

3.19.2 Acupuncture and the spinal cord

The spinal cord is hypothesized to be the primary level of acupuncture analgesia, and the underlying mechanism may be associated with the release of certain neurotransmitters, such as 5-hydroxytryptamine (5-HT), somatostatin, and substance P (SP) [Qiao et al., 2011]. Furthermore, opioid peptides may be involved in acupuncture analgesia in the spinal cord to varying degrees (Zyloney et al., 2011). Pharmacological inhibition of ascending nociceptive control at the spinal cord, nucleus accumbens, or supraspinal may prevent acupuncture-induced analgesia (Tobaldini et al., 2014)

3.19.3 Acupuncture and the brain stem

The brain stem is the relay station for sorting, discriminating, and synthesizing information associated with pain. A proposed mechanism underlying acupuncture-induced analgesia in the brain stem involves the activation of the reticular formation of the brain stem descending pain-inhibitory system. It is associated with a variety of neurotransmitters involved in analgesia, such as 5-HT and opioid peptides (Zhang et al., 2012).

Zhang et al. (2014) studied how electroacupuncture blocks pain by activating a variety of bioactive chemicals through peripheral, spinal, and supraspinal mechanisms.

The studies show that electroacupuncture activates the nervous system differently in health condition than in pain conditions, alleviates both sensory and affective inflammatory pain, and inhibits inflammatory and neuropathic pain more effectively at 2 to 10 Hz than at 100 Hz.

Subsequently, these studies demonstrated that peripheral opioids play a central role in electroacupuncture inhibition of inflammatory pain by blocking proinflammatory cytokine release from polymorphonuclear leukocytes and mononuclear cells and by acting on peripheral opioid receptors to desensitize peripheral sensory nerves (Figure 23)

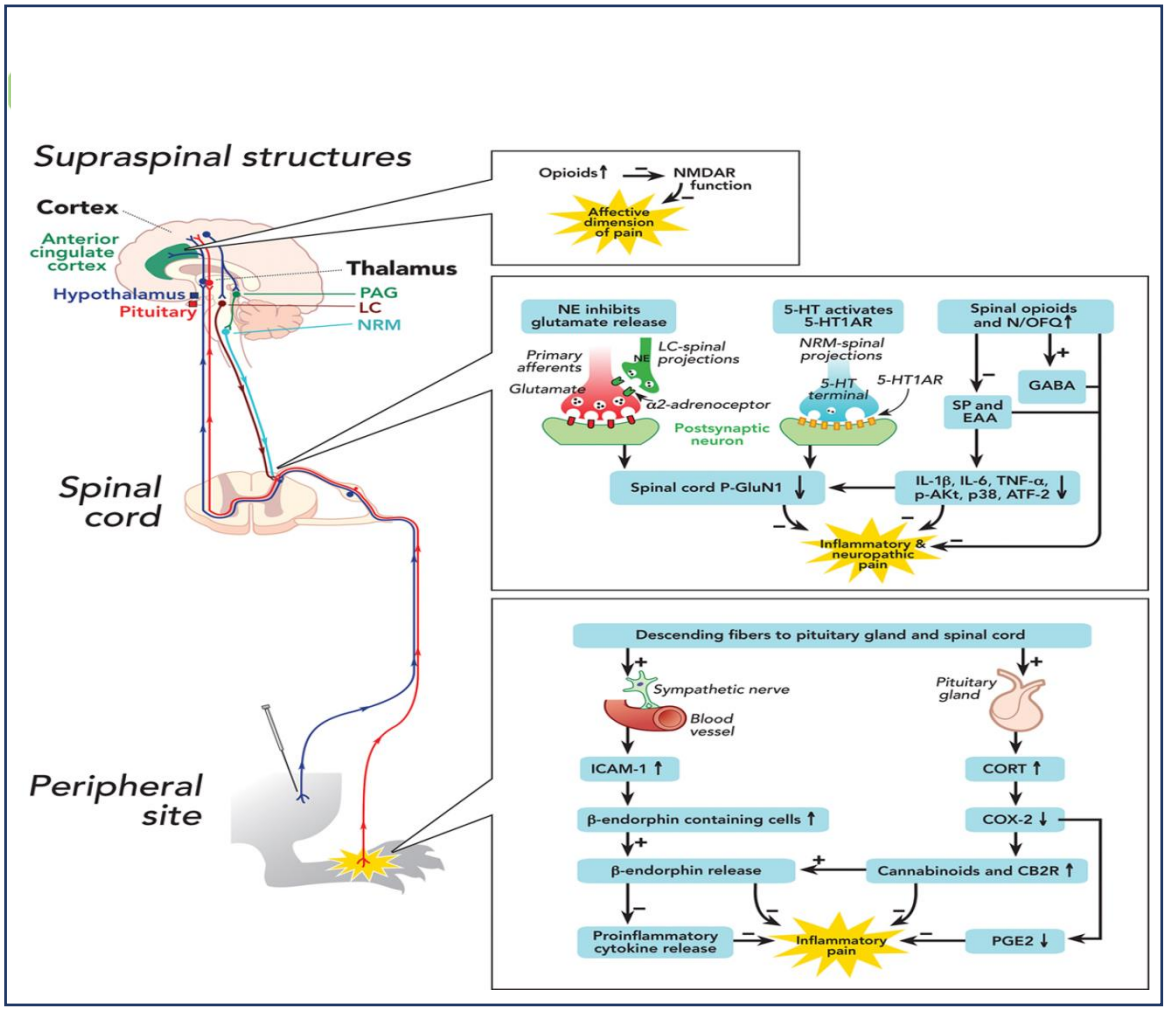


Figure 23: Electroacupuncture mechanism on persistent pain

3.19.4 Acupuncture and anti-inflammatory theory

Inflammation is a vital defence mechanism in the human body. Inflammatory diseases are important acupuncture indicators. Acupuncture is becoming more popular in Western medicine as an anti-inflammatory treatment. Neurons required for acupuncture's anti-inflammatory response have been discovered by researchers (Caruso, 2021). Harvard Medical School neuroscientists have elucidated the underlying neuroanatomy of acupuncture, which activates a specific signalling pathway.

According to Li et al. (2021), localized acupuncture-mediated anti-inflammatory effects involve the regulation of multiple immune cell populations and functions, including macrophages, granulocytes, mast cells, and T cells. Acupuncture causes macrophages to switch from M1 to M2, and the negative TLR4 regulator PPAR is activated, inhibiting the intracellular TLR/MyD88 and NOD signalling pathways. Acupuncture then inhibits the downstream IB/NF-B and P38 MAPK (Mitogen-activated protein kinase) pathways, resulting in decreased production of inflammasome and proinflammatory mediators.

Researchers led by Torres-Rosas et al. (2014) reported that electroacupuncture, a modern version of traditional acupuncture that uses electrical stimulation, could reduce cytokine storms in mice by activating the vagal-adrenal axis, a pathway wherein the vagus nerve signals the adrenal glands to release dopamine. Acupoint selection, stimulation intensity, body state, and other factors all contribute to acupuncture's anti-inflammatory effect.

3.19.5 Acupuncture and neurotransmitters/modulators

Acupuncture research (Wen, He, Lu, & Xia, 2010), particularly mechanistic studies on acupuncture analgesia, shows that the acupuncture signal, whether generated by

manual acupuncture or electroacupuncture (EA), significantly influences the release, synthesis, reuptake, and degradation of the central neurotransmitters/modulators, including monoamines (e.g., serotonin, noradrenaline, and dopamine),

Acupuncture increases the activity of endogenous opioid peptides, serotonin, dopamine, ACh, and inhibitory amino acids like -aminobutyric acid (GABa), glycine, taurine, and lactamine while decreasing the activity of noradrenalin and excitatory amino acids like glutamate and aspartic acid (Han, 2004; Lai, Lin, Hsieh, 2019). A long period of acupuncture may cause excessive CCK-8 production and depletion of some pro-acupuncture substances, resulting in the so-called acupuncture effect.

3.20 Safety aspects of acupuncture.

One of the main draws of TCM for many patients is its safety. TCM treatments, such as acupuncture, are seen as less invasive, more natural, and less likely to cause side effects than other forms of traditional treatment. According to Van Hal, Dydyk, and Green. (2021), there are very few strict contraindications to acupuncture. Vincent (2001) found that the early literature on the safety of acupuncture consisted entirely of case reports. Rampes and James (1995) summed up all case reports from 1966 to 1993 and discovered 395 instances of complications.

Many of the injuries were minor, such as bruising or fainting, but 216 were serious, including several cases of pneumothorax and spinal cord injury. Only one acupuncture-related death was reported, in which a needle penetrated the pericardium.

Green, Buchbinder, and Hetrick (2005) discovered that the side effects of acupuncture were not measured in many of the studies they reviewed in their quest to

determine the safety of acupuncture treatment. However, they discovered a study that found that side effects such as fainting, headaches, dizziness, swelling, or leg weakness were comparable to those of real or fake acupuncture.

In a study involving 652 acupuncturists (White, 2006), a reported adverse event rate of 10.2 percent was discovered. According to the study, acupuncture's most common side effects were fatigue (3%), bleeding or bruising (3%), worsening of symptoms (2%), and pain at the needling site (2%). The result shows that there were no significant adverse events.

The researcher concluded that the risks of acupuncture are negligible, and that acupuncture is a very safe treatment in the hands of competent practitioners. All the adverse events and complications associated with acupuncture and related therapies that have been reported in published systematic reviews to date (Chan et al., 2017) suggest that adverse events are rare and frequently minor.

Witt et al. (2009) investigated the safety of acupuncture. A prospective observational study of 229,230 patients found that acupuncture administered by physicians is a relatively safe treatment. This finding is supported by Mallory et al. (2016), who discovered that when performed properly by trained professionals, acupuncture is a safe and effective modality.

In another study, Kawakita and Okada (2014) concluded that the evidence from large-scale perspective surveys indicates that acupuncture therapy is safe and that serious adverse events and deaths caused by acupuncture therapy are uncommon.

A study by Chan et al. (2017) shows that acupuncture can cause both minor and serious adverse events. Because many adverse events came from case reports and many of

the reviews did not include full details about the number of participants in their included studies, incidence rates, related confidence intervals (CIs), and p values could not be calculated. However, according to all of the reviews, adverse events are uncommon and frequently minor.

3.21 Current reviews of acupuncture for MSP

Acupuncture is increasingly used as a non-drug therapy to treat shoulder pain (Green, Buchbinder, & Hetrick, 2005). In recent years, a large number of randomized controlled trials (RCTs) of acupuncture for chronic pain have been conducted (Vickers et al., 2010). Acupuncture appears to be an effective and safe treatment for shoulder pain disorders, according to numerous studies (Asheghan et al., 2016).

Despite the fact that large randomized controlled trials (RCTs) and meta-analyses have strongly supported acupuncture's effectiveness for pain management, evidence about its value in terms of its effectiveness and safety for shoulder pain disorder issues is still lacking.

However, establishing evidence for the efficacy of acupuncture is difficult. More scientific evidence is required to back up the clinical effects of acupuncture in pain management. As a result, a critical analysis of the literature on RCTs for acupuncture was conducted in order to obtain a much clearer picture of the current state of clinical research in the area of acupuncture effectiveness and safety in treating shoulder pain disorders.

A comprehensive search strategy was designed to search all the available literature related to this research topic. An electronic literature search was conducted on the following multiple electronic databases: PubMed, CrossRef, Google Scholar, PMC free

articles, ScienceDirect, Eric, and Web of Science. PubMed and Google Scholar were used as the main databases. Abstracts, reviews, full-text articles, clinical trials, systematic reviews, randomized control trials, and meta-analysis were searched. Relevant search terms such as "traditional Chinese medicine", "alternative therapy", "acupuncture", "electroacupuncture", "shoulder pain", "pain management", "shoulder disorder", "pain relief", "safety", "chronic", "acute", "rotator cuff", "shoulder impingement", "tendinitis", "frozen shoulder", "glenohumeral joint", "adhesive capsulitis", "acupuncture safeness", "acupuncture" and "acupuncture" was used.

Multiple electronic databases from January 2012 to March 2022 were used to source articles for the review. Two main electronic databases (PubMed and Google Scholar) were searched. The search process ended in March 2022.

Due to language limitations, only English databases were searched. Articles were screened according to the title and then selected after the abstracts were read. Only full-text articles that meet the inclusion criteria were extracted.

Since non-RCT studies on acupuncture for shoulder pain were not included in this study, all non-RCT studies were disregarded. As a result, only 22 RCT studies were included in this study to determine the effectiveness and safety of acupuncture treatment for shoulder pain disorders.

Table 6 and Table 7 shows the summary characteristics of 22 included RCTs of acupuncture for shoulder pain disorders. Six RCTs of acupuncture for shoulder pain disorders without co-intervention are summarized in Table 6, while sixteen RCTs of acupuncture for shoulder pain disorders with co-intervention are summarized in Table 7.

3.20.1 Authors, year, country, participants, and numbers of publications

Referring to Table 6 and Table 7, a total of 22 RCTs on acupuncture for shoulder pain disorders were included which in total had 1,808 participants. The 22 RCTs were published from year 2006 to 2020. Of the 22 studies, twelve were from China (Chen et al., 2019; Zhang et al., 2016; Chai, 2019; Lu et al., 2019; Lu et al., 2019; Shi et al., 2019; Zhang et al., 2019; Shang et al., 2012; Goa et al., 2014; Sheng & Shi, 2013; Ni et al., 2013; and Bao et al., 2012), three studies were from Spain (Garrido et al., 2016; Arias Buria et al., 2015; and Vas et al., 2008), two studies from Sweden (Johansson et al., 2005 and Johansson et al., 2011), two studies from Taiwan (Ma et al., 2006 and Lo et al., 2020), and one each from Turkey (Kibar et al., 2017), Iran (Asheghan et al., 2016) and Greece (Papadopoulos et al., 2019).

The languages of the publications were English. The number of participants in each study ranged from 21 to 425. The study with the most participants had 425 individuals. The majority of the included RCTs stated that the rationale for acupuncture point selection was based on TCM theory.

Table 6: Summary characteristics of 6 included RCTs of acupuncture for shoulder pain disorders without co-interventions.

Author/Year/ Country	Condition	Sample size (TG/CG)	Treatment duration	Without Co-Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Chen (2019) China	RC injury	40 (20/20)	6 weeks 5 times/week	EA	Exercise	1.Pain, function, shoulder ROM 2.Post treatment ***Not reported***	1. Favours EA: TG>CG 2.No difference: TG=CG
Kibar (2017) Turkey	Shoulder pain lasting more than 3 months	73 (36/37)	3 weeks 3 trial/week	LA	Sham-LA	1.Reduction in SPADI 2.Reduction in VAS 3.Reduction in PGA, DGA ***Not reported***	1.TG>CG (P<0.001) 2.TG>CG (P<0.001) 3.TG>CG (P<0.001)
Garrido (2016) Spain	Unilateral injury with clinical symptoms	68 (35/33)	4 weeks 1 trial/week	MA	Sham-MA	1.Reduction in VAS 2.Increase in Kruskal-Wallis test ***No severe adverse events***	1.G>CG (P<0.05) 2.TG>CG (P<0.05)
Johansson (2005) Sweden	Shoulder impingement syndrome	85 (44/41)	5 weeks 2 trial/week	MA	Ultrasound	1.Reduction in CMS 2.Increase in Kruskal-Wallis test 3.Increase in Al-score ***No adverse events***	1.TG>CG (P=0.045) 2.TG>CG (P=0.045) 3.TG>CG (P=0.045)
Zhang (2016) China	Chronic shoulder pain (Clinical)	80 (38/42)	TG: 4 weeks 5 times/week CG: 4 weeks Daily	Contralateral MA	PT	1.Pain VAS 2.Reduction in VAS ***No adverse events***	1.Favours MA: TG>CG 2.No difference
Ma (2006) Taiwan	Frozen shoulder	75 (30/30/15)	MA; 4 weeks 8 treatments PT: 4 weeks 20 treatments	MA	1.PT 2.MA+PT	ROM, VAS, SF36 Health Survey (ADL) 1.Pain reduced in AC 2.ROM improved more in PT ***Not reported***	1.TG<CG 2.MA + PT had the best outcome

TG: treatment group; CG: control group; EA: electroacupuncture; MA: manual acupuncture (traditional Chinese acupuncture); LA: laser acupuncture; PT: physical therapy; SPADI: shoulder pain and disability index; VAS: visual analog scale; PGA: patient's global assessment; DGA: doctor's global assessment; ADL: ability in daily life; ROM: range of motion, CMS: Constant-Murley Score; and Al-score: Adolfsson-Lysholm shoulder score.

Table 7: Summary characteristics of 16 included RCTs of acupuncture for shoulder pain disorders <u>with</u> co-interventions.

Author /Year/ Country	Condition	Sample size (TG/CG)	Treatment duration	With Co-Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Johansson (2011) Sweden	Shoulder impingement syndrome	91: (42/49)	5 weeks 2 trial/week	MA + Exercise	Corticosteroid injection + Exercise	1.Reduction in VAS 2.Increase in Al-score ***No severe adverse events***	1.No differences 2.No differences
Arias Buria (2017) Spain	Non-traumatic shoulder in pain	50: (25/25)	5 weeks 1 trial/week	MA + Exercise	Exercise	1.Reduction in NRS 2.Increase in DASH questionnaire ***No severe adverse events***	1.No deference 2.TG>CG (P<0.01)
Vas (2008) Spain	Unilateral subacromial syndromes	425: (205/220)	4 weeks 1 trial/week	MA + Physiotherapy	Mock TENS + Physiotherapy	1.Reduction in CMS 2.Reduction in NRS ***No severe adverse events***	1.TG>CG (P<0.001) 2.TG>CG (P<0.001)
Chai (2019) China	Supraspinatus tendinitis	60: (30/30)	2 weeks 1week post-treatment	MA + tropical NSAID	ESWT+ tropical NSAID	Pain, shoulder abduction ROM, ***Not reported***	Favours MA: TG>CG No difference
Lu. H (2019) China	Supraspinatus tendinitis (clinical)	40: (30/30)	TG:40 days/ once every other day CG: 6 weeks Once a week	EA + ESWT	ESWT	Pain, function, proportion of improved participants ***No adverse events***	Favours EA: TG>CG No difference
Lu. M (2019) China	RC tear (Clinical and imaging)	60: (30/30)	3 weeks 5 times/week	MA + MT	MT	Proportion of improved participants ***No adverse events***	Favours MA: TG>CG No difference
Papadopoulos (2019) Greece	Supraspinatus calcific tendinitis	40: (20/20)	TG: 3 weeks 2 session/week Oral medication: 3 weeks/ session not reported Exercise: 3 weeks 5 times daily	EA + Oral medication + Exercise	Oral medication + exercise	Pain, ROM (forward elevation, abduction) ***Not reported***	Favours EA +oral medication: TG>CG No difference
Shi (2019) China	RC tear (Clinical and imaging)	104: (52/52)	6 weeks Session not reported	EA+ MT	MT	Pain, function, ROM ***Not reported***	Favours EA +MT TG>CG No difference

Table 7: Continued.

Author/Year/ Country	Condition	Sample size (T/C group)	Treatment duration	With Co-Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Lo (2020) Taiwan	Frozen shoulder syndrome	21 (11/10)	6 weeks 18 sessions 2-3 session/week	EA + PT	Sham EA + PT	1.Decrease in VAS 2.Increase in SPADI, ROM ***No adverse events***	1.TG>CG 2.No significant change between the two groups in VAS, SPADI. ROM in the follow-up periods
Zhang (2019) China	Scapulohumeral periarthritis	64 (32/32)	4 weeks 6 times/week	MA + Ashi points	Ashi points	VAS, CMS, HAMA, cured, effective, or ineffective ***Not reported***	TG>CG Significant improvement of both groups compared to the control.
Asheghan (2016) Iran	Frozen shoulder	40 (20/20)	MA: twice/week PT: once every other day 6 weeks	MA + PT	PT	SPADI, VAS, ROM Follow-up: 1.5 months 3 months ***Not reported***	In ROM TG>CG After 3 months: VAS TG>CG (P < 0.05). No difference in SPADI
Shang (2012) China	Frozen shoulder	64 (32/32)	12 Days. once every day	MA + AQF	MA	Cured, improved: failed ADL Pain and moving functions of shoulder and ADL improved. ***Not reported***	TC>CG (P < 0.05). Statistically significant improvement in both groups
Gao (2014) China	Poststroke shoulder pain	75 (25/25/25)	4 weeks 6 times/week	MA + RH	1.MA 2.RH	1.Decrease in VAS 2.Improve in FMA ***No adverse events***	1.TC>CG (P<0.001) 2.Had a significant effect
Sheng & Shi (2013) China	Poststroke shoulder pain	60 (33/27)	4 weeks Once every day	MA + RH	RH	FMA ***No adverse events***	TC>CG (P<0.001) Had a significant effect
Ni (2013) China	Poststroke shoulder pain	64 (32/32)	60 days Once every day	MA + RH	RH	1.Decrease in VAS 2.Improve in FMA ***No adverse events***	1.TC>CG (P<0.001) 2.Had a significant effect
Bao (2012) China	Poststroke shoulder pain	129 (46/41/42)	30 days Once every day	EA + RH	1.EA 2.RH	FMA Improve in FMA ***No adverse events***	TC>CG (P<0.001) Had a significant effect

MA: manual acupuncture; EA: electroacupuncture; PT: Physical training; MT: manual therapy; RH: rehabilitation treatment; NRS: numeral rating scale; DASH: disability of arm, shoulder, and hand; NSAID: non-steroidal anti-inflammatory drug; TENS: transcutaneous electric nerve stimulation; RC: rotator cuff; ESWT: extracorporeal shock wave therapy; HAMA: Hamilton Anxiety Scale; FMA: the Fugl-Meyer Assessment; AOF: accelerating Qi-flow along meridians

3.20.2 Conditions reported

The conditions or diagnosis reported in these studies are: 4 cases of poststroke shoulder pain (Gao et al., 2014; Sheng & Shi, 2013; Ni et al., 2013; and Bao et al., 2012); 4 cases of frozen shoulder (Asheghan et al., 2016; Shang et al., 2012; Lo et al., 2020; and Ma et al., 2006), one case of scapulohumeral periarthritis (Zhang et al., 2019); 3 cases of supraspinatus tendinitis (Chai, 2019; Lu et al., 2019 and Papadopoulos et al., 2019); 2 cases of unilateral subacromial syndrome (Vas et al., 2008; and Garrido et al., 2016); 2 cases of shoulder impingement syndrome (Johansson et al, 2005; and Johansson et al, 2011); 3 cases of rotator cuff injuries or tears (Chen et al., 2019; Lu et al., 2019; and Shi et al., 2019); and 3 cases of chronic shoulder pain (Kibar et al., 2017; Zhang et al.,2016; and Arias Buria et al., 2015).

3.20.3 Acupuncture without co-interventions

Among the 22 selected trials, 13 used manual acupuncture, 7 used electroacupuncture, 1 used laser acupuncture, and 1 used contralateral acupuncture with or without other treatments as the intervention in the treatment group. Six of the twenty-two trials involved acupuncture treatments without co-interventions (Chen et al., 2019; Kibar et al., 2017; Garrido et al., 2016; Johansson et al., 2005; Zhang et al., 2016; and Ma et al., 2006). Two trials compared acupuncture to physical therapy (Zhang et al., 2016; and Ma et al., 2006). In one trial, acupuncture was compared to ultrasound treatment (Johansson et al., 2005), and in another trial, acupuncture was compared to sham acupuncture (Garrido et al., 2016). Kibar et al. (2010) studied laser acupuncture versus sham laser acupuncture, whereas Chen et al. (2019) studied electroacupuncture versus exercise.

3.20.4 Acupuncture with co-interventions

Sixteen trials involve acupuncture treatment with co-interventions (Chai, 2019; Lu et al., 2019; Lu et al., 2019; Shi et al., 2019; Zhang et al., 2019; Shang et al., 2012; Goa et al., 2014; Sheng & Shi, 2013; Ni et al., 2013; Bao et al., 2012; Asheghan et al., 2016; Papadopoulos et al., 2019; Johansson et al., 2011; Lo et al., 2020; Arias Buria et al., 2015; and Vas et al., 2008). Out of sixteen trials, one trails compared acupuncture plus manual therapy with manual therapy alone (Lu M et al., 2019).

One trail compared electroacupuncture plus ESWT with ESWT alone (Lu.H et al., 2019.) Two trails compared acupuncture plus rehabilitation to rehabilitation alone (Sheng & Shi, 2013 and Ni et al., 2013).

Other comparisons consisted of acupuncture plus exercise versus corticosteroid injection plus exercise (Johansson et al., 2011), acupuncture plus exercise compares versus exercise alone (Arias Buria et al., 2015), acupuncture plus physiotherapy versus mock TENS plus physiotherapy (Vas et al., 2008), acupuncture plus tropical NSAID versus ESWT plus tropical NSAID (Chai, 2019), electroacupuncture plus oral medication plus exercise versus oral medication plus exercise (Papadopoulos et al., 2019), electroacupuncture plus manual therapy versus manual therapy alone (Shi et al., 2019), electroacupuncture plus physical therapy versus sham electroacupuncture plus physical therapy (Lo et al., 2020), acupuncture plus Ashi points versus Ashi points alone (Zhang et al., 2019), acupuncture plus physical therapy verse physical therapy alone (Asheghan et al., 2016), acupuncture plus accelerating Qi-flow along meridian (AQF) versus acupuncture alone (Shang et al., 2012), acupuncture plus rehabilitation versus acupuncture and rehabilitation (Goa et al., 2014), and electroacupuncture plus rehabilitation versus electroacupuncture and rehabilitation (Bao et al., 2012).

3.20.5 Assessment indicators

As assessment indicators, the most frequently used measurement scales for the pain status of the shoulder were the VAS (Visual Analogue Scale). Ten trails used VAS to assess the level of pain (Kibar et al., 2017; Garrido et al., 2016; Ma et al., 2006; Zhang et al., 2016; Johansson et al., 2011; Lo et al., 2020; Zhang et al., 2019; Asheghan et al., 2016; Gao et al., 2014; Ni et al., 2013). ROM (range of motion) was assessed in six trails (Ma et al., 2006; Chai, 2019; Asheghan et al., 2016; Papadopoulos et al., 2019; Lo et al., 2020; Shi et al.,2019). Three trails used the CMS (Constant-Murley score) to assess the overall shoulder function based on pain (Johansson et al., 2005; Vas et al., 2008; and Zhang et al., 2019). Three trails used FMA (Fugl-Meyer Assessment) for motor impairment of post stroke shoulder pain (Gao et al., 2014; Ni et al., 2013; and Bao et al., 2012). Two trails used Kruskal-Wallis test, a statistical test to determine whether or not there is a statistically significant difference between the medians of three or more independent groups. Only two trails used SPADI to asses assess pain and disability (Kibar et al., 2017 and Lo et al., 2020).

3.20.6 Safety of Acupuncture

Regarding adverse effects of acupuncture, 9 studies did not report any adverse effects of acupuncture in their trials **(**Kibar et al., 2017; Ma et al., 2006; Zhang et al., 2019; Asheghan et al., 2016; Papadopoulos et al., 2019; Shi et al., 2019; Chai, 2019; Shang et al., 2012; and Chen et al., 2019). Another 9 studies reported that there were no adverse effects of acupuncture in their trials (Lo et al., 2020; Ni et al., 2013; Gao et al., 2014; Sheng & Shi, 2013; Johansson et al., 2005; Bao et al., 2012; Zhang et al., 2016; Lu et al., 2019; and Lu et al., 2019). Only four studies reported some adverse effects of acupuncture in their trials. The adverse effects were

categorised as "not severe effects" (Vas et al., 2008; Johansson et al., 2011; Garrido et al., 2016; and Arias Buria et al., 2015).

3.20.7 Conclusion

In six studies involving acupuncture treatment without co-intervention, one study concluded that when comparing acupuncture as an intervention to control groups, acupuncture was more effective than sham acupuncture for relieving shoulder pain. The results show a reduction in VAS and an increase in the Kruskal-Wallis test in the acupuncture group compared to the sham-acupuncture group. There was a significant difference in the analysed results between the two groups (Garrido et al., 2016). There were no severe adverse effects reported in this trial. One study comparing acupuncture to ultrasound treatment for shoulder pain disorders, concluded that both groups improved in shoulder pain relief. Even though both groups improved, but the acupuncture group improved more than the other.

There was a reduction in the CMS, increase in Kruskal-Wallis test, and increase in the Al-score, but the acupuncture group had a larger improvement in the combined score. The results suggest that acupuncture is more efficacious than ultrasound for relieving shoulder pain disorders. There were no severe adverse effects reported in this trial (Johansson et al., 2005). One trial reported that electroacupuncture is much better than exercise in improving pain reduction, shoulder function, and shoulder ROM in the short term for rotator cuff injuries. However, the results show that there was no significant difference between electroacupuncture and exercise in improving shoulder pain and shoulder function in the long term. No adverse effects of acupuncture were reported in this trial (Chen et al., 2019). For chronic shoulder pain, Kibar et al. (2010) compared laser acupuncture to sham-laser acupuncture. SPADI, VAS, PGA, and DGA scores all improved significantly. The results show all parameters in the treatment group showed statistically significant improvements. All pain and functional status parameters

in the treatment group were significantly better than in the control group. They came to the conclusion that laser acupuncture outperformed sham laser acupuncture. There were no reported side effects. Zhang et al. (2016) discovered a reduction in VAS in both interventions when comparing contralateral acupuncture to physical therapy for chronic shoulder pain.

Even though the results favor acupuncture over physical therapy, there is no statistically significant difference between the two interventions. When comparing acupuncture to physical therapy and acupuncture to acupuncture plus physical therapy, Ma et al. (2006) found that acupuncture plus physical therapy produced the best results. Acupuncture was found to reduce pain, and physical therapy improved ROM. No adverse effects were reported.

The majority of the included trials in sixteen studies involving acupuncture with co-intervention were more optimistic about acupuncture combined with other therapies than the control group. Johansson et al. (2011) compared acupuncture plus exercise to corticosteroid injection plus exercise. They found that both subacromial corticosteroid injections and a series of acupuncture treatments combined with home exercises reduced pain and improved shoulder function in patients with shoulder impingement syndrome (SIS), but neither was significantly better than the other. In a similar study Aris Buria et al. (2015) compared acupuncture plus exercise to exercise alone. Their findings show that incorporating acupuncture into an exercise program resulted in greater clinical improvement in shoulder pain-related disability in people suffering from subacromial pain syndrome.

Acupuncture, on the other hand, had no effect on change in shoulder pain because both groups improved at all follow-up periods. Acupuncture had no adverse effects in either study. Vas et al. (2008) compared acupuncture and physiotherapy to a control group that received only TENS and physiotherapy. The findings show that acupuncture combined with physiotherapy improves shoulder function and reduces pain when compared to physiotherapy

alone, but there is no significant difference between these two groups. For supraspinatus tendinitis and rotator cuff tears, two studies (Lu, H., 2019; and Lu, M., 2019) compared electroacupuncture plus manual therapy to manual therapy alone. Both have improved in terms of pain and shoulder function. The results favor electroacupuncture combined with manual therapy over manual therapy alone. There was, however, no difference between the treatment and control groups.

When comparing electroacupuncture plus oral medication plus exercise to oral medication plus exercise, Papadopoulos et al. (2019) found that while the intervention group improved in pain intensity and range of motion more than the control group, there was no statistically significant difference in quality of life. Shi et al. (2019) found that, while electroacupuncture plus manual therapy is superior to manual therapy alone in terms of pain reduction, function improvement, and range of motion, there is no statistically significant difference between the two groups.

Asheghan et al. (2016) compared acupuncture plus physical therapy to physical therapy alone, and Lo et al. (2020) compared electroacupuncture plus physical therapy to sham electroacupuncture plus physical therapy. Preliminary data from both studies show a decrease in VAS and an increase in SPADI and ROM. The studies concluded that electroacupuncture plus physical therapy outperformed sham electroacupuncture plus physical therapy, and acupuncture plus physical therapy outperformed physical therapy alone, but there was no significant difference in VAS, SPADI, or ROM between the groups in the follow-up periods. In another study, Shang et al. (2012) compared acupuncture with accelerating Qi-flow along meridians (AQF) to acupuncture alone. Both groups show significant improvements in pain reduction, shoulder movement function, and "ability in daily life" (ADL). Both groups showed statistically significant improvement. In conclusion, acupuncture plus AQF was superior to

acupuncture alone. When acupuncture plus rehabilitation was compared to rehabilitation alone, all four studies (Gao et al., 2014; Sheng & Shi, 2013; Ni et al., 2013; and Bao et al., 2012) indicated that combined treatment (acupuncture plus rehabilitation) had a significant effect greater than single treatment (rehabilitation) in VAS, and FMA. Acupuncture plus ashi points was compared to ashi points alone by Zhang et al. (2019). When acupuncture and ashi point treatments are combined, the results show a significant improvement over single ashi point treatments. Finally, most of the trials included were more optimistic about the combined treatment group (acupuncture combined with other treatment or therapy) than the control group (single treatment or therapy)

CHAPTER 4

METHODOLOGY

This chapter describes in detail the methodology used in this research. Included in this chapter are topics such as research design, search strategy, inclusion and exclusion criteria, types of studies, types of participants, types of interventions, literature search, and research limitations.

4.1 Research Design

This is a non-interventional study. The goal of this study is to evaluate and critically review the application of acupuncture treatment in terms of its effectiveness and safety in relation to current musculoskeletal shoulder pain in adults. Since the aim of this study is to critically review the effectiveness and safety of acupuncture treatment in treating shoulder pain, a significant number of qualitative and quantitative research databases on the subject are required. Therefore, a critical narrative review methodology was employed for this research.

Narrative reviews, also known as semi-systematic reviews, are a type of scientific research where they provide a synthesis of published literature on a topic and describe its current state of art (Synder, 2019). A narrative review aims to identify and summarise previously published material to avoid duplication, and identify new research areas that have not yet been explored (Derish, 2011).

Since a narrative review consists of a critical analysis of the literature published in books and electronic or paper-based journal articles (Abdullah et al., 2016), it is most suitable for this research. Moreover, this method situates my research as it enables me to evaluate trends

within my research topic, synthesise evidence, and provide summary information. This method enables a mixed-methods approach, in which both qualitative and quantitative data can be used in this research.

There is a certain weakness in the quality of narrative reviews in comparison to systematic reviews. The main difference between systematic reviews and narrative reviews is that the main objective of a systematic review is to formulate a well-defined research question and use qualitative and quantitative methods to analyse all the available evidence attempting to answer the question. In contrast, narrative reviews can address one or more questions with a much broader scope.

However, the narrative review's quality was attempted to be improved by synthesising some systematic review guidelines, such as article selection methods, rigorous evaluation, results, and evidence-based conclusions.

Ferrari (2015) recommends that the quality of the current review method can be improved by synthesizing certain guidelines from other systematic review methodologies. The main aim of this recommendation is to reduce bias in the selection of articles for review while at the same time employing an effective bibliographic research strategy. This recommendation helps in preparing a reliable narrative review of clinical research.

Unlike systematic reviews that benefit from guidelines such as the PRISMA statement, there are no acknowledged guidelines for narrative reviews (Ferrari, 2015). Since there is no consensus on the standard structure for narrative writing, the preferred format is the IMRAD (Table 7). IMRAD stands for introduction, methods, results, and discussion (Bae, 2014). While the IMRAD format may be sufficient for narrative reviews, researchers may also consider using a similar but more robust structure such as IAMRDC (Introduction, Aim, Methods, Results,

Discussion, and Conclusion). Unlike systematic reviews, narrative reviews do not require a method section. However, if the method section is included, then it clarifies the key messages of narrative reviews (Gasparyan, Ayvazyan, Blackmore, & Kitas, 2011).

Table 8 displays the visuals for the general framework of narrative reviews that has been proposed.

Table 8: General framework of narrative reviews

Introduction • Content: Describe the rational • Structure: Organization of the collected information • Limits: Define the Objective(s) and scope
Method/Literature Search • Searching Strategy: Data base, keywords • Inclusion/exclusion criteria: type of studies, language, time periods, others • Verify the availability of all the selected studies • Citing and listing the researched references
Central body/Discussion *Section 1* First key concepts: • discuss and evaluate • summarize in relation to research query
Section 2 Another key concept: • Discuss and evaluate • Summarize in relation to research query
More added sections Another key concept: • Discuss and evaluate • Summarize in relation to research query
Conclusions From each summarized section: • highlight the main points • connect with the research needs repeat the meaning for research design
Abstract • According to the journal style • Descriptive per structured (IMRAD) pattern

4.2 Search strategies

A comprehensive search strategy was designed to search all the available literature related to this research topic. The search strategy was intentionally of low specificity to enable the maximum extent of relevant studies to be identified and included. An electronic literature search was conducted on the following multiple electronic databases: PubMed, CrossRef, Google Scholar, PMC free articles, ScienceDirect, Eric, and Web of Science. The database language was set to English. Abstracts, reviews, full-text articles, clinical trials, systematic reviews, randomized control trials, and meta-analysis were searched. Relevant controlled vocabulary supplemented with keywords such as "traditional Chinese medicine", "alternative therapy", "acupuncture", "electroacupuncture", musculoskeletal shoulder pain", "shoulder pain management", "acupuncture safety", "shoulder impingement", "tendinitis", "frozen shoulder", "glenohumeral joint", and "adhesive capsulitis", were used to search for clinical trials of the effect and safety of acupuncture treatment for musculoskeletal shoulder pain in adults. Multiple electronic databases from August 2023 to January 2024 were used to source articles for the review. The search process ended on January 24, 2024. Due to language limitations, only English databases were searched. Articles are screened according to the title and then selected after the abstracts are read. Only full-text articles that meet the inclusion criteria were downloaded.

Data pertaining to acupuncture treatment, its effectiveness, and its safety were extracted for assessing musculoskeletal shoulder pain (MSP). Those findings were scrutinised by looking at the supporting evidence for their effect and application, as well as the safety aspects. A search strategy was used, which included summarising the topic, identifying main concepts (keywords), identifying synonyms, using alternate words, and/or related words, and experimenting with different keyword combinations. To narrow or broaden the search, Boolean

operators (AND, OR, and NOT) were used. Finally, to narrow down the search results, search filters were used.

4.3 Inclusion criteria

4.3.1 Types of studies

Regardless of publication type, this review included only RCTs of acupuncture for MSP, with or without blinding. Only studies with well-defined hypotheses, objectives, settings, participants (with inclusion or exclusion criteria), assessments, interventions, results, and conclusions were selected. The sample size of every study must be more than ten patients.

4.3.2 Types of participants

All adult participants or subjects (aged 18 years or over) with musculoskeletal shoulder pain were considered regardless of gender, race, ethnicity, region, and religion. Most of the participants in these included trials were patients from outpatient clinics. All types of shoulder pain, whether acute or chronic, were considered as long as the area of the pain was localized to the scapula and humerus, with their surrounding muscles, tendons, and ligaments. Most types of shoulder pain, such as adhesive capsulitis, shoulder impingement, frozen shoulder, rotator cuff injury, labrum injury, bursitis, arthritis, tendonitis, and shoulder pain due to recovering from surgery, are included.

4.3.3 Types of interventions

Acupuncture (either traditional Chinese acupuncture or electro acupuncture [EA]) was compared to the following control interventions: sham acupuncture or sham EA, pharmacological (western medication), and other therapies or treatment (such as physical

therapy, physiotherapy, ultrasound, ESWT, physical training, ashi point acupuncture, trigger point acupuncture, or exercise therapy). Co-interventions were allowed as long as all trial arms received the same co-intervention.

For the purposes of this review, there are no limitations on the types of needles, duration of treatment, or number of treatments. There is some limitation on points of stimulation whereby only body acupuncture points, tender points (ashi points), and trigger points are considered.

4.4 Exclusion Criteria

The subjects listed below will be excluded from this study. First, duplicate articles as well as data that cannot be obtained or is incomplete; Second, other types of acupuncture, such as hydroacupuncture, fire needle acupuncture, or warm needle acupuncture, bee venom acupuncture, and small “needle-knife” acupuncture (due to a lack of studies); Third, studies involving acupuncture points other than body acupuncture points (ear acupuncture or microsystem acupuncture). Fourth, involving participants with fractures, severe dislocations or sprains, terminal disease, mental diseases, cognitive impairment, or serious infection; Fifth, acupuncture in conjunction with other treatments, such as Chinese herbal medicine; and sixth, observational studies, cross-over studies, animal studies, conference abstracts, letters, and studies involving children.

4.5 Outcome Measures

A treatment or intervention outcome measure is the result of a treatment or intervention that is used to objectively determine a patient's baseline function at the start of a clinical trial.

The same instrument can be used to determine progress and efficacy after the treatment or intervention has begun.

This study included two types of outcome measures: primary and/or secondary outcome measures. In any case, if none of the primary and/or secondary outcomes were measured, the studies would only be considered for qualitative synthesis.

4.5.1 Primary outcomes

The primary outcomes include pain intensity as measured by pain scores or scales such as the visual analogue scale (VAS), numerical rating scale (NRS), Constant-Murley Score (CMS), patient global assessment (PGA), and doctor global assessment (DGA).

4.5.2 Secondary outcomes

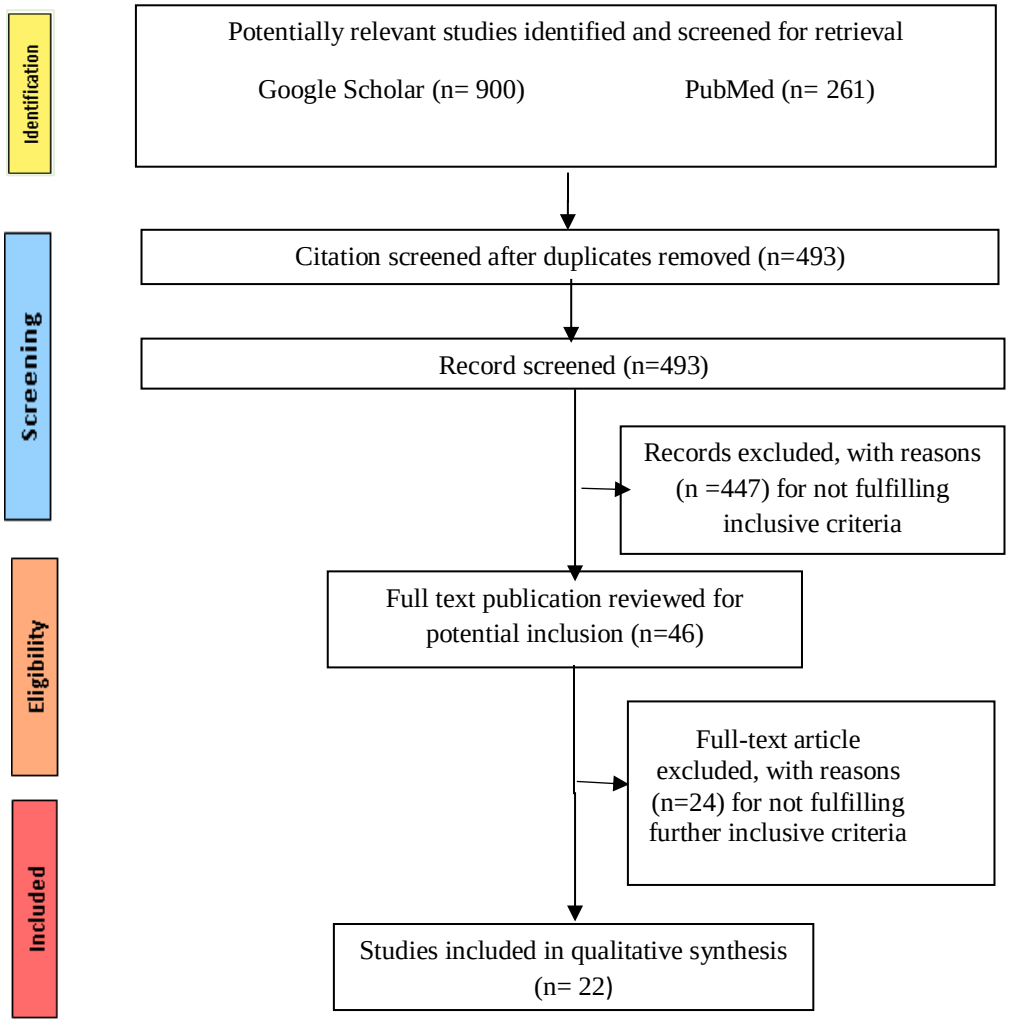
Secondary outcomes include shoulder dysfunction, effective rates, and adverse effects. The shoulder functionality measurement includes range of motion (ROM), the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire (Appendix 9), the Shoulder Pain and Disability Index (SPADI), and the Fugl-Meyer Motor Assessment (FMA). Range of motion (ROM) measures the change in degrees of abduction, adduction, flexion, extension, supination, and pronation.

4.6 Literature search.

The literature search for this research adopts the same features as the systematic review search methodology. Figure 24 shows a modified literature selection process for the research using some guide lines from the literature selection process in systematic review.

The titles and abstracts of 1,161 potentially relevant studies were identified and screened for retrieval. A total of 493 citations were screened after duplicates were removed (668).

Figure 24: Flow chart of the literature selection process for the research.



Again, another 447 records were excluded, with reasons for not fulfilling inclusive criteria. A total of 46 full-text publications were reviewed for potential inclusion. Again, another 24 full-text articles were excluded for not fulfilling further inclusive criteria (incomplete text, missing data, incomplete reporting, and absence of adverse events reports). Finally, 22 studies were included in the qualitative synthesis.

Full text of the articles was obtained only when abstracts described acupuncture treatment, its effectiveness and safety for musculoskeletal shoulder pain, the causes and effects of shoulder pain, the safety of acupuncture treatment, the adverse effects of acupuncture, and the effects of acupuncture treatment combined with conventional medicine or other forms of alternative medicine.

4.7 Research limitations.

This is non-interventional research. Materials and information for this study were acquired from publicly available documents via electronic databases. It is non-experimental research and does not involve any human participation. Therefore, the requirement for institutional ethics approval and ethical approval of any participants, such as their written consent and their right to privacy, does not arise. This study has several limitations, which means the results should be interpreted cautiously. The potential limitation of this research is that the current study only searched English-lamguage electronic databases to identify potential studies published in English. Due to language barriers, databases in other languages such as Chinese, Korean, and German were not searched or missed out. After the United States of America, China ranked highest in the number of publications, followed by Korea (Park et al., 2021). Most importantly, some of the included studies were of poor quality and had methodological flaws. An electronic literature search was conducted on a limited number of electronic databases such as PubMed and Google Scholar to identify potentially relevant studies for this research. Another limitation is that the present review did not incorporate clinical studies, non-randomized studies, and unpublished data, which may result in the loss of important information in the field of acupuncture. Attempts have been made to mitigate some of the shortcomings of this type of research in comparison to systematic reviews by

synthesizing some systematic review guidelines, such as article selection methods, rigorous evaluation, results, and evidence-based conclusions.

CHAPTER 5

RESULTS

Non-pharmacologic and non-opioid pain therapies should be considered first-line treatment for mild or moderate pain or as an adjunct to opioids or other medications.

This chapter presents the findings and the results of the critically reviewed RCTs that used acupuncture to treat musculoskeletal shoulder pain (MSP).

5.1 The search findings

This chapter presents the findings of 22 RCTs. Following the established search strategies, a total of 1,161 references from English databases were retrieved from electronic databases from August, 2023, until January, 2024.

A total of 493 citations were screened after duplicates were removed. Due to their inability to meet additional inclusion requirements, 447 more records were excluded. For possible inclusion, 46 full-text publications were reviewed.

Once more, twenty-four full-text articles were eliminated because they did not meet additional inclusion criteria, were incomplete controlled studies, reported incorrectly, were irrelevant, or were not well-fitting.

In conclusion, only 22 studies were included in this critical narrative review. Full text of the articles was obtained only when abstracts described acupuncture treatment, its application and effectiveness for shoulder pain and shoulder disorders, the causes and effects of shoulder pain disorders, the safety of acupuncture treatment, the adverse effects of acupuncture, and the effects of acupuncture treatment combined with conventional medicine or other forms of alternative medicine. Figure 24 depicts the study selection process.

5.2 Description of the study

All 22 included RCTs were published in English. The studies were published from 2005 to 2020. Of the 22 studies, twelve studies (55%) were from China (Chen et al., 2019; Zhang et al., 2016; Chai, 2019; Lu et al., 2019; Lu et al., 2019; Shi et al., 2019; Zhang et al., 2019; Shang et al., 2012; Goa et al., 2014; Sheng & Shi, 2013; Ni et al., 2013; and Bao et al., 2012); three studies (14%) were from Spain (Garrido et al., 2016; Arias Buria et al., 2015; and Vas et al., 2008); two studies (9%) from Sweden (Johansson et al., 2005 and Johansson et al., 2011; two studies (9%) from Taiwan (Ma et al., 2006 and Lo et al., 2020); and one each from Turkey (Kibar et al., 2017); Iran (Asheghan et al., 2016); and Greece (Papadopoulos et al., 2019). The sample size, participants, interventions, and outcomes of the included RCTs are summarised below.

5.2.1 Sample sizes

The included studies' sample sizes varied. The number of participants in each study ranged from 21 to 425 individuals. The study with the most participants included 425 individuals, and the study with the fewest participants included 21 participants. Five studies had sample sizes between 40 and 59 participants (Chen et al., 2019; Lu et al., 2019; Papadopoulus et al., 2019; Asheghan et al., 2016; and Aris Baria et al., 2015); ten studies had sample sizes between 60 and 79 participants (Kibar et al., 2017; Garrido et al., 2016; Ma et al., 2006; Chai et al., 2019; Lu M et al., 2019; Zhang et al., 2019; Shang et al., 2012; Gao et al., 2014; Sheng & Shi, 2013; and Ni et al., 2013); and three studies had sample sizes between 80 and 99 participants (Johansson et al., 2005; Zhang et al., 2016; and Johansson et al., 2011), while the sample size of the remaining three studies was 104 participants (Shi et al., 2019); 129 participants (Bao et al., 2012); and 425 participants (Vas et al., 2008). The smallest sample size

was 21 participants (Lo et al., 2020), and the biggest sample size was 425 participants (Vas et al., 2008).

5.2.2 Types of participants

These randomised studies included a total of 1,808 participants. They ranged in age from 20 to 75 years old. Only seven of the 22 included studies clearly reported the age range and mean of the participants (Lo et al., 2020; Johansson et al., 2005; Vas et al., 2008; Johansson et al., 2011; Arias-Buria et al., 2015; Garrido et al., 2016; and Kibar et al., 2017). The remaining studies did not report either the age range, the mean of the participants' ages, or both. The gender participation in all 22 studies was not clearly indicated.

All the included studies were related to various types of shoulder pain (MSP), such as rotator cuff ruptures or injuries, rotator conditions or diseases, shoulder impingement syndrome, rotator cuff tendinopathy tendinitis, calcific tendinitis, subacromial bursitis, subacromial pain syndrome, frozen shoulder, glenohumeral subluxation, brachial plexus injuries, or spasticity in shoulder muscles.

All the participants involved were diagnosed with MSP (clinical, as well as clinical and imaging). The studies looked into four types of shoulder pain: first, post-stroke shoulder pain (Bao et al., 2012; Sheng & Shi, 2013; Ni et al., 2013; and Gao et al., 2014); second, frozen shoulder (Ma et al., 2006; Shang et al., 2012; Asheghan et al., 2016; Zhang et al., 2019; and Lo et al., 2020); third, shoulder impingement syndrome (Johansson et al., 2005; Vas et al., 2008; Johansson et al., 2011; Arias-Buria et al., 2015; Garrido et al., 2016; and Kibar et al., 2017); and fourth, rotator cuff disease (Zhang et al., 2016; Chen et al., 2019; Lu. M., 2019; Papadopoulos et al., 2019; Shi et al., 2019; Lu. H., 2019; and Chai, 2019). The conditions or diagnosis reported in these studies are: four cases of poststroke shoulder pain (Gao et al., 2014;

Sheng & Shi, 2013; Ni et al., 2013; and Bao et al., 2012); four cases of frozen shoulder (Asheghan et al., 2016; Shang et al., 2012; Lo et al., 2020; and Ma et al., 2006), one case of scapulohumeral periarthritis (Zhang et al., 2019); three cases of supraspinatus tendinitis (Chai, 2019; Lu. H, 2019 and Papadopoulos et al., 2019); two cases of unilateral subacromial syndrome (Vas et al., 2008; and Garrido et al., 2016); two cases of shoulder impingement syndrome (Johansson et al, 2005; and Johansson et al, 2011); three cases of rotator cuff injuries or tears (Chen et al., 2019; Lu. M, 2019; and Shi et al., 2019); and three cases of chronic shoulder pain (Kibar et al., 2017; Zhang et al.,2016; and Arias Buria et al., 2015). Only three studies revealed that participants experienced chronic shoulder pain. The remaining 19 studies did not specify whether the shoulder pain conditions were acute or chronic.

5.2.3 Types of interventions

There were four forms of acupuncture intervention used in the treatment group: traditional Chinese acupuncture (manual acupuncture), electroacupuncture (EA), laser acupuncture, and contralateral acupuncture.

Fourteen studies used traditional Chinese acupuncture, that is, manual acupuncture (Garrido et al., 2016; Johansson et al., 2005; Ma et al., 2006; Johansson et al., 2011; Arias-Buria et al., 2015; Vas et al., 2008; Chai, 2019; Lu, M et al., 2019; Zhang et al., 2019; Asheghan et al., 2016; Shang et al., 2012; Gao et al., 2014; Sheng & Shi, 2013; and Ni et al., 2013). Six studies used EA, that is, the modern variation of acupuncture (Chen et al., 2019; Lu. H., 2019; Papadopoulos et al., 2019; Shi et al., 2019; Lo et al., 2020; and Bao et al., 2012).

One study used modern laser acupuncture (Kibar et al., 2017), and another study used contralateral acupuncture (Zhang et al., 2016). Out of 22 studies, only twelve provided clear

information on the specific acupuncture points that were used (Bao et al., 2012; Sheng & Shi., 2013; Gao et al., 2014; Ma et al., 2006; Shang et al., 2012; Zhang et al., 2019; Lo et al., 2020; Johansson et al., 2005; Vas et al., 2008; Johansson et al., 2011; Garrido et al., 2016; Kibar et al., 2017). Refer to Table 9.

Table 9: Acupuncture points mentioned in 12 studies

Author/Year	Condition	Local acupuncture point	Distal acupuncture point
Kibar et al. (2017)	Shoulder pain lasting more than 3 months	GB 21, LI 14, LI 15, LI 16, SI 9, SI 10, SI 11, TE14, and TE 15	LI 4, LI 10, LI 11
Garrido et al. (2016)	Unilateral injury with clinical symptoms	LI 14, LI 15, LI 16, SI 9, TE 14	ST 38
Johansson et al. (2005)	Shoulder impingement syndrome	LU 1, LI 14, LI 15, and TE 14	LI 4
Ma et al. (2006)	Frozen shoulder	LI 15,	LI 4, GB 20, GB 34
Johansson et al. (2011)	Shoulder impingement syndrome	LU 1, LI 14, LI 15, and TE 14	LI 4
Vas et al. (2008)	Unilateral subacromial syndromes	*No*	ST 38
Lo et al, (2020)	Frozen shoulder syndrome	LI 15, TE 14,	GB 34, ST 10, ST 38
Shang et al, (2012)	Frozen shoulder	LI 14, LI 15, TE 14, and SI 9	TE 5, LI 11
Gao et al. (2014)	Poststroke sholder pain	HT 1, LI 15, SI 9, SI 11, and TE14,	LI 11, LI 10, LI 4, PC 6, TE 5
Sheng & Shi. (2013)	Poststroke sholder pain	*No*	EX-HN I, GV20, SP10, ST36, ST40, BL20, and BL21
Bao et al. (2012)	Poststroke sholder pain	LI 10, LI 11, LI 14, LI 15, TE14, and SI 9	TE5
Zhang et al, (2019)	Scapulohumeral periarthritis	*ashi point*	SI 19, LI 20, TE 3, TE 23, S1 3, and LI 4,

In one study, specific trigger points (non-acupuncture points) were used, such as acupuncture points at the supraspinatus, infraspinatus, deltoid, teres minor, and teres major muscles (Arias-Buria et al., 2015). Ni et al. (2013) used ashi points (tender points at the affected part) as the main acupuncture points in the treatment group. In another study (Zhang et al., 2019), ashi points were used in treatment and control groups. However, the remaining eight studies did not describe the specific acupuncture point used in their trials (Chai, 2019; Lu. H et

al., 2019; Asheghan et al., 2006; Papadopoulos et al., 2019; Shi et al., 2019; Chen et al., 2019; Lu. H et al., 2019; and Zhang et al., 2016).

From the twelve studies (refer to Table 8), nine studies made use of both local and distal acupuncture points (Bao et al., 2012; Gao et al., 2014; Ma et al., 2006; Shang et al., 2012; Lo et al., 2020; Johansson et al., 2005; Johansson et al., 2011; Garrido et al., 2016; and Kibar et al., 2017).

The remaining three studies based their treatment on the distal acupuncture points only (Vas et al., 2008; Sheng & Shi, 2013; and Zhang et al., 2019). Two studies (Arias-Buria et al., 2015; and Ni et al., 2013) used only local non-acupuncture points (ashi points and trigger points).

The acupuncture points used in these studies were CV 12 (Zhongwan), KI 17 (Shangqu), HT 1 (Jiquan), LU 1 Zhongfu), LU 10 (Yuji), GB 21 (Jianjing), LI 1 (ShangYang), LI 4 (Hegu), LI 11 (Quchi), LI 14 (Binao), LI 15 (Jianyu), LI 16 (Jugu), SI 3 (Houxi), SI 9 (Jianheng), SI 10 (Naoshu), SI 11 (Tianzong), SI 19 (Tinggong), TE 5 (Waiguan), TE 14 (Jianliao), TE 15 (Tianliao), PC 6 (Neiguan), BL 20 (Pishu), BL 21 (Feishu), ST 10 (Shuitu), ST 36 (Zusanli), ST 38 (Tiaokou), ST 40 Fenglong), SP 10 (Xuehai), GV 20 (Baihui), and GB 34 (Yanglingquan).

The most frequently used acupuncture points in these studies were LI 15 (8 studies), TE 14 (8 studies), SI 9 (4 studies), and LI 14 (4 studies). LI 1, LU 1, PC 6, SI 10, GB 20, BL 20, BL 21, GV 20, Gb 34, ST 36, and ST 40 are the list used acupuncture points in these studies. The most common meridian types used are the large intestine (LI 1, LI 4, LI 11, LI 14, LI 15, and LI 16) [10 studies], triple burner (TE 5, TE 14, and TE 15) [9 studies], small intestine (SI

3, SI 9, SI 10, SI 11, and SI 19) [7 studies], stomach (ST 36, ST 38, and ST 40) [4 studies], gallbladder (GB 20, GB 34) [3 studies], and bladder (BL 20, and BL 21) [2 studies].

LI-11 (Quchi) was the most often used acupuncture point for poststroke shoulder pain treatment (Gao et al., 2014; Bao et al., 2012). LI 15 (Jianyu) was the most often used as an acupuncture point for shoulder impingement pain treatment (Johansson et al., 2005; Johansson et al., 2011; and Garrido et al., 2016). Meanwhile, LI 15 (Jianyu) was again indicated as the most used acupuncture point for frozen shoulder (Ma et al., 2006; Shang et al., 2012; and Lo et al., 2020).

The majority of the included RCTs stated that the rationale for acupuncture point selection was based on TCM theory (Bao et al., 2012; Sheng & Shi., 2013; Gao et al., 2014; Ma et al., 2006; Shang et al., 2012; 2016; Zhang et al., 2019; Lo et al., 2020; Johansson et al., 2005; Vas et al., 2008; Johansson et al., 2011; Garrido et al., 2016; and Kibar et al., 2017). Only one study (Kibar et al., 2017) used western medical acupuncture techniques (laser acupuncture).

Regarding needle positioning, four studies indicated that they performed acupuncture on the affected parts directly (Kibar et al., 2017; Zhang et al., 2019; Ni et al., 2013; and Arias-Buria et al., 2015). One study applied acupuncture to the healthy side (opposite side) of the affected shoulder (Zhang et al., 2016). Six studies (Sheng & Shi., 2013; Zhang et al., 2019; Vas et al., 2008; Ma et al., 2006; Garrido et al., 2016; and Lo et al., 2020) used certain distal acupuncture points (ST 36, ST 38, ST 40, BL 20, BL 21, KI 17, GV 20, and GB 34). The other 11 studies do not explicitly state the locations of the acupuncture points that were used (Zhang et al., 2016; Chen et al., 2019; Lu. M., 2019; Papadopoulos et al., 2019; Shi et al., 2019; Lu. H., 2019; Asheghan et al., 2016; and Chai, 2019; Arias-Buria et al., 2015; Ni et al., 2013; and Zhang et al., 2019).

Six studies provided clear information about the depth of the needle insertion (Johansson et al., 2005; Vas et al., 2008; Johansson et al., 2011; Arias-Buria et al., 2015; Garrido et al., 2016; and Kibar et al., 2017). The depth of the needle insertion ranged from 0.3-5 cm. In two studies, needles were inserted between 0.3 and 1 cm deep (Johansson et al., 2005; and Johansson et al., 2011). In one study, the depth of the needle insertion ranged from 3-3.5 cm (Arias-Buria et al., 2015). In another study, needles were inserted about 2 -3 cm deep (Garrido et al., 2016). Vas' study reported 4.5-5.0 cm in depth, whereas Kibar's study reported 4 cm in depth. The average needle depth across the six studies was 2.42 cm. The other 16 studies either did not report the depth of the needle insertion or had no information found in their studies.

The duration of needle retention time was reported to be between 5 and 40 minutes. Six studies clearly reported the retention time for needling during acupuncture treatment (Johansson et al., 2005; Vas et al., 2008; Johansson et al., 2011; Arias-Buria et al., 2015; Garrido et al., 2016; and Kibar et al., 2017). Two studies retained the needles for 20 minutes (Vas et al., 2008; and Garrido et al., 2016). Two studies retained the needles for 30 minutes each (Johansson et al., 2005; and Johansson et al., 2011). One study found needle retention for 40 minutes (Kibar et al., 2017), while another found needle retention for 5-10 minutes (Arias-Buria et al., 2015), during the acupuncture session. The remaining 16 studies either omitted to mention or found no data regarding the length of time the needles were retained during acupuncture treatments.

The duration of the treatment in all 22 studies varied from 12 days to 8 weeks. The treatment duration of one study was 12 days (Shang et al., 2012). The treatment duration of another study was 2 weeks (Chai, 2019). Three studies conducted three weeks of treatment **(**Kibar et al., 2017**;** Lu. M., 2019; and Papadopoulos et al., 2019). The treatment duration for

eight studies was 4 weeks (Garrido et al., 2016; Zhang et al., 2016; Ma et al., 2006; Vas et al., 2008; Zhang et al., 2019; Gao et al., 2014; Sheng & Shi., 2013; and Bao et al., 2012). The treatment duration of another four studies was five weeks (Johansson et al., 2005; Johansson et al., 2011; Lo et al., 2020; Arias-Buria et al., 2015). Five studies were conducted over six weeks of treatment (Lu. H., 2019; Shi et al., 2019; Shi et al., 2019; Asheghan et al., 2016; and Chen et al., 2019). Only one study conducted eight weeks of treatment (Ni et al., 2013).

In these studies, a follow-up treatment following the final treatment was observed. After the final treatment, only three studies provided follow-up information. These studies indicated a one-to-six month follow-up period after the final treatment. For one study (Lo et al., 2020), the follow-up treatment lasted from one to six months, and for another study, it lasted from one to two months (Zhang et al., 2019). The follow-up treatment for Chai's (2019) study lasted just one week. The remaining 19 studies did not provide any data or information on follow-up.

The frequency of acupuncture treatments was reported in most of the studies. However, the frequency of treatments varied across all the studies. Twenty studies clearly indicated the frequency of treatments throughout the studies. Three studies reported acupuncture treatment once every day (Bao et al., 2012; Sheng & Shi, 2013; and Ni et al., 2013). One study reported acupuncture treatment once every other day (Lu. H., 2019).

Three studies reported acupuncture treatment once a week (Garrido et al., 2016; Arias-Buria et al., 2015; Vas et al., 2008). Six studies had two treatments per week (Johansson et al., 2005; Johansson et al., 2011; Papadopoulos et al., 2019; Lo et al., 2020; Ma et al., 2006; and Asheghan et al., 2016). One study had two to three treatments per week (Lo et al., 2020). One study shows three treatments per week (Kibar et al., 2017).

Two studies found five weekly treatments to be effective (Lu. M., 2019; Zhang et al., 2016), and two studies found six weekly treatments to be effective (Gao et al., 2014; Zhang et al., 2019). Three studies did not report the frequency of acupuncture treatments per week throughout the study period (Chai, 2019; Shi et al., 2019; and Shang et al., 2012).

The total number of acupuncture treatments (sessions) per study varied across all the studies. It varied between 4 and 60 sessions. Two studies show a total of four sessions (Garrido et al., 2016; Vas et al., 2008). Two studies showed a total of five to six sessions (Arias-Buria et al., 2015; and Papadopoulos et al., 2019). Two studies showed a total of eight to nine sessions (Kibar et al., 2017; Ma et al., 2006). Two studies showed a total of ten sessions of acupuncture treatments (Johansson et al., 2005; and Johansson et al., 2011). Two studies indicated a total of twelve to fifteen sessions (Lu and M., 2019; Asheghan et al., 2016). Two studies had eighteen to twenty sessions each (Zhang et al., 2016; Ni et al., 2013).

Three studies showed twenty-four to twenty-eight sessions (Zhang et al., 2019; Gao et al., 2014; and Sheng & Shi., 2013). Two studies showed thirty sessions of acupuncture treatments (Chen et al., 2019; Bao et al., 2012). One study showed a total of forty sessions (Lu. H., 2019), and another study showed a total of sixty acupuncture sessions (Ni et al., 2013). Three studies provided no information on the total number of acupuncture sessions administered during the course of the studies (Shang et al., 2012; Chai, 2019; and Shi et al., 2019).

According to eight studies, the intervention group and the control group received the same number of treatments (sessions) (Gao et al., 2014; Sheng & Shi., 2013; Bao et al., 2012; Lo et al., 2020; Ni et al., 2013; Zhang et al., 2019; Shang et al., 2012; Lu. M., 2019). Six studies reported that the number of treatment sessions for each intervention group and control group varied (Ma et al., 2006; Asheghan et al., 2016; Lu. H., 2019; Papadopoulos et al., 2019; Chai,

2019; Chen et al., 2019). Seven studies (Shi et al., 2019; Kibar et al., 2017; Arias-Buria et al., 2015; Johansson et al., 2005; Johansson et al., 2016; Arias-Buria et al., 2015; and Vas et al., 2008) did not clearly state the number of acupuncture sessions for each intervention group and control group.

The included studies were divided into two subgroups: a single intervention group without co-interventions and an intervention group with co-interventions. Refer to Table 10 below.

Table 10: A summary of 6 RCTs with single intervention without co-intervention

Author/Year	MSP Condition	Single intervention (Treatment group)	Intervention (Control group)
Johansson et al. (2005)	Shoulder impingement syndrome	Acupuncture	Ultrasound
Ma et al. (2006)	Frozen Shoulder	Acupuncture	1.Physical therapy 2.Physical therapy plus acupuncture
Zhang et al. (2016)	Chronic shoulder pain	Contralateral acupuncture	Physical therapy
Garrido et al. (2016)	Unilateral shoulder injury	Acupuncture	Sham-acupuncture
Kibar et al., 2017	Chronic shoulder pain	Laser acupuncture	Sham-laser acupuncture
Chen et al. (2019)	Rotator cuff injury	Electroacupuncture	Exercise

Six studies were conducted without co-intervention (Kibar et al., 2017; Ma et al., 2006; Garrido et al., 2016; Zhang et al., 2016; Johansson et al., 2005; and Chen et al., 2019). Manual acupuncture, electroacupuncture, contralateral acupuncture, and laser acupuncture make up the interventions in the active treatment group. Exercise, sham acupuncture, sham laser acupuncture, ultrasound, physical therapy, and acupuncture plus physical therapy make up the interventions in the control group. In one study, acupuncture was compared with sham acupuncture (Garrido et al., 2016). In another study, laser acupuncture was compared with sham-laser acupuncture (Kibar et al., 2017).

In a different study (Chen et al., 2019), acupuncture was compared to exercise, while in another related study (Zhang et al., 2019), acupuncture was compared to physical therapy. Finally, one study compared the effects of acupuncture to physical therapy and acupuncture plus physical therapy (Ma et al., 2006).

Acupuncture (intervention) with co-intervention was applied in sixteen studies. The intervention groups with co-intervention are divided into two subgroups: a single co-intervention group, and a multiple co-intervention group. There were fifteen studies with a single co-intervention group (Bao et al., 2012; Sheng & Shi., 2013; Gao et al., 2014; Shang et al., 2012; Zhang et al., 2019; Lo et al., 2020; Johansson et al., 2011; Lu. M., 2019; Shi et al., 2019; Lu. H., 2019; Asheghan et al., 2016; and Chai, 2019; Vas et al., 2008; Ni et al., 2013; and Arias-Buria et al., 2015).

The single co-interventions used in these studies are: exercise, physiotherapy, tropical NSAIDs, manual therapy (a specialized physical therapy), physical therapy, ashi points acupuncture, acupuncture accelerating *Qi*-flow along meridians (AQF), extracorporeal shock wave therapy (ESWT), and rehabilitation treatment. Refer to Table 11.

Table 11: A summary of 15 RCTs <u>with</u> single intervention plus single co-intervention

Author/Year	MSP Condition	Intervention with co intervention (Treatment group)	Intervention in control group.
Vas et al., 2008	Unilateral subacromial syndromes	Acupuncture + Physiotherapy	Mock TENS + Physiotherapy
Johansson et al. (2011)	Shoulder impingement syndrome	Acupuncture + Exercise	Corticosteroid injection + exercise
Shang et al. (2012)	Frozen shoulder	Acupuncture + AQF	Acupuncture
Bao et al. (2012)	Poststroke shoulder pain	Electroacupuncture + Rehabilitation	1. Electroacupuncture 2. Rehabilitation
Sheng & Shi. (2013)	Poststroke sholuder pain	Acupuncture + Rehabilitation	Rehabilitation
Ni et al. (2013)	Poststroke shoulder pain	Acupuncture + Rehabilitation	Rehabilitation
Gao et al. (2014)	Poststroke shoulder pain	Acupuncture + Rehabilitation	1.Acupuncture 2. Rehabilitation
Arias-Buria et al. (2015)	Non-traumatic shoulder pain	Acupuncture + Exercise	Exercise
Asheghan et al. (2016)	Frozen shoulder	Acupuncture + Physical therapy	Physical therapy
Lu. H (2019)	Supraspinatus tendinitis	Electroacupuncture + ESWT	ESWT

Lu. M (2019)	RC tear	Acupuncture + Manual therapy	Manual therapy
Zhang et al. (2019)	Scapulohumeral periarthritis	Acupuncture + Ashi points	Ashi points
Shi et al. (2019)	RC tear	Electroacupuncture + Manual therapy	Manual therapy
Chai (2019)	Supraspinatus tendinitis	Acupuncture + Tropical NSAID	ESWT+ Tropical NSAID
Lo et al. (2020)	Frozen shoulder	Electroacupuncture + Physical therapy	Sham Electroacupuncture + Physical therapy

Two studies used exercise as a co-intervention (Johansson et al., 2011; Arias Burfa et al., 2015). Manual therapy was used in two studies (Lu. M. et al., 2019; and Shi et al., 2019). One study used physiotherapy (Vas et al., 2008). Another study used tropical NSAIDs (Chai, 2019).

Two studies used physical therapy (Lo et al., 2020; Asheghan et al., 2016). One study used ashi point acupuncture (Zhang et al., 2019). One study used AOF (Shang et al., 2012). Four studies used rehabilitation therapy (Gao et al., 2014; Sheng & Shi., 2013; Ni et al., 2013; and Bao et al., 2012), and another study used ESWT as a co-intervention (Lu.H., 2019).

The interventions used in the control group of the first subgroup consist of corticosteroid injection plus exercise; exercise alone; mock TENS plus physiotherapy; extracorporeal shock wave therapy (ESWT) plus tropical NSAIDs; manual therapy alone; oral medication plus exercise; sham electroacupuncture plus physical therapy; ashi point acupuncture; physical therapy alone; acupuncture alone; and electroacupuncture alone.

Out of fifteen studies, one study compared acupuncture plus manual therapy with manual therapy alone (Lu. M et al., 2019). One trial compared electroacupuncture plus ESWT with ESWT alone (Lu.H et al., 2019). Two studies compared acupuncture plus rehabilitation with rehabilitation alone (Sheng & Shi, 2013; and Ni et al., 2013). Other comparisons consisted of acupuncture plus exercise versus corticosteroid injection plus exercise (Johansson et al., 2011), acupuncture plus exercise versus exercise alone

(Arias Buria et al., 2015), acupuncture plus physiotherapy versus mock TENS plus physiotherapy (Vas et al., 2008). The other comparisons done in these studies are acupuncture plus tropical NSAID versus ESWT plus tropical NSAID (Chai, 2019), electroacupuncture plus manual therapy versus manual therapy alone (Shi et al., 2019), and electroacupuncture plus physical therapy versus sham electroacupuncture plus physical therapy (Lo et al., 2020).

Other comparisons made in these studies are acupuncture plus ashi points versus ashi points alone (Zhang et al., 2019), acupuncture plus physical therapy versus physical therapy alone (Asheghan et al., 2016), and acupuncture plus accelerating Qi-flow along meridian (AQF) versus acupuncture alone (Shang et al., 2012). Only one study used a single intervention plus multiple-co-interventions (Papadopoulos et al., 2019), that is, electroacupuncture plus oral medication plus exercise versus oral medication plus exercise (Papadopoulos et al., 2019).

The interventions used in this study are electroacupuncture plus oral medication plus exercise. The interventions used in the control group were oral medication plus exercise. Refer to Table 12.

Table 12: A summary of a single intervention with multiple co-intervention

Author/Year	MSP Condition	Intervention with co multiple intervention (Treatment group)	Intervention in control group.
Papadopoulos et al. (2019)	Supraspinatus calcific tendinitis	Electroacupuncture + Oral medication + Exercise (n=20)	Oral medication + exercise (n=20)

5.2.4 Types of outcome measures

This study included two types of outcome measures: primary and secondary outcome measures. The primary outcomes include pain intensity as measured by pain scores or scales such as the Visual Analogue Scale (VAS), the numerical rating scale (NRS), the Constant-

Murley Score (CMS), the Patient Global Assessment (PGA), and the Doctor Global Assessment (DGA).

Secondary outcomes include shoulder dysfunction and adverse effects. The shoulder functionality indicators include range of motion (ROM), the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, the Shoulder Pain and Disability Index (SPADI), the effective rate, the Kruskal-Wallis test, the Adolfsson-Lysholm Shoulder Assessment Score (AL-score), and the Fugl-Meyer Motor Assessment (FMA).

Range of motion (ROM) measures the change in degrees of abduction, adduction, flexion, extension, supination, and pronation.

5.2.4.1 Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS) is a pain rating scale that is commonly used to assess the intensity of shoulder pain before and after treatment. Among the 22 included studies, ten assessed acupuncture's effects on pain intensity using VAS (Garrido et al., 2016; Kibar et al., 2017; Zhang et al., 2016; Ma et al., 2006; Johansson et al., 2011; Lo et al., 2020; Zhang et al., 2019; Asheghan et al., 2016; Goa et al., 2014; Ni et al., 2013).

5.2.4.2 Numerical Rating Scale (NRS)

Two studies assessed acupuncture effects on pain intensity using NRS (Vas et al., 2008; and Arias Buria et al., 2015).

5.2.4.3 Constant-Murley Score (CMS)

Three studies assessed the acupuncture effects on shoulder function using CMS (Vas et al., 2008; Zhang et al., 2019; and Johansson et al., 2005).

5.2.4.4 Patient Global Assessment (PGA) and Doctor Global Assessment (DGA)

One study examined the effects of acupuncture on shoulder pain and shoulder function using indicators of the patient's global assessment (PGA) and the doctor's global assessment (DGA) (Kibar et al., 2017). PGA is one of the patient-reported outcomes whose content is associated with pain, functional limitation, psychological distress, and comorbidities related to MSP.

5.2.4.5 Range of Motion (ROM)

Six studies assessed the acupuncture effects on both shoulder pain and shoulder functionality using ROM (Ma et al., 2006; Chai, 2019; Papadopoulos et al., 2019; Shi et al., 2019; Lo et al., 2020; Asheghan et al., 2016).

5.2.4.6 Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire

One study assessed the acupuncture effects on shoulder functionality using DASH (Arias Buria et al., 2015). Refer to Appendix 9.

5.2.4.7 Shoulder Pain and Disability Index (SPADI)

Three studies assessed the acupuncture effects on both shoulder pain and shoulder functionality using SPADI (Kibar et al., 2017; Lo et al., 2020; and Asheghan et al., 2016).

5.2.4.8 Fugl-Meyer Motor Assessment (FMA)

The Fugl-Meyer Assessment (FMA) is a performance-based impairment index for stroke patients. Four studies assessed the acupuncture effects on shoulder function using FMA. (Gao et al., 2014; Ni et al., 2013; Shi et al., 2013; and Bao et al., 2012).

5.2.4.9 Kruskal-Wallis Test

Two studies used the Kruskal-Wallis test to assess acupuncture effects on shoulder function (Garrido et al., 2016; Johansson et al., 2005).

5.2.4.10 Adolfsson-Lysholm Shoulder Assessment Score (AL-score)

Only one study used the AL-score to assess shoulder pain and shoulder functionality in this review (Johansson et al., 2005).

5.2.4.11 Adverse Events

Among the 22 included studies, fourteen provided information on adverse events during the acupuncture treatment for MSP. No one reported any serious adverse events that occurred throughout the study period.

Nine studies reported that no adverse events were observed throughout the study period (Gao et al., 2014; Ni et al., 2013; Bao et al., 2012; Lo et al., 2020; Lu. H et al., 2019; Lu. M et al., 2019; Zhang et al., 2016; Johansson et al., 2005; and Sheng & Shi, 2013). Another four studies reported that no severe adverse events were observed throughout the study period (Johansson et al., 2011; Garrido et al., 2016; and Arias-Buria et al., 2015).

Headaches, dizziness, loss of strength in the leg, worsening symptoms of pain over several days, and an inflammatory response are a few of the adverse events of acupuncture reported in these studies.

The remaining nine studies did not provide any details about adverse events in their studies (Chen et al., 2019; Kibar et al., 2017; Ma et al., 2006; Chai, 2019; Papadopoulos et al., 2019; Shi et al., 2019; Zhang et al., 2019; Asheghan et al., 2016; and Shang et al., 2012).

5.3 Effects of interventions on pain, shoulder function, and adverse events

The following reports compared the effects of acupuncture to those of sham acupuncture, other therapies, or other treatments, either with or without co-intervention for MSP.

5.3.1 Acupuncture versus Sham Acupuncture

Two studies compared acupuncture with sham acupuncture (Garrido et al., 2016; Kibar et al., 2017). Garrido et al. (2016) compared manual acupuncture with sham manual acupuncture, whereas Kibar et al. (2010) compared laser acupuncture with sham laser acupuncture. Garrido et al. (2016) conducted trials on unilateral injuries with clinical symptoms, whereas Kibar et al. (2017) conducted trials on shoulder pain lasting more than 3 months. Garrido et al. (2016) used two assessment indicators to evaluate shoulder pain: VAS and the Kruskal-Wallis test, whereas Kibar et al. (2017) used three assessment indicators in their study: VAS, SPADI, and PGA or DGA.

Both studies evaluated the pain intensity using VAS. Visual Analogue Scale (VAS) scores (0-10) were used to assess levels of pain, where higher scores represent a greater level of pain. Refer to table 13.

Table 13: Summary of outcome measures in acupuncture versus sham acupuncture

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Garrido et al. (2016)	Unilateral injury with clinical symptoms	(A) Acupuncture (n=35)	(B) Sham-acupuncture (n=33)	1.Reduction in VAS 2.Increase in Kruskal-Wallis test *No severe events*	1.TG>CG (P<0.05) 2.TG>CG (P<0.05)
Kibar et al. (2017)	Shoulder pain lasting more than 3 months	(A) Laser Acupuncture (n=36)	(B) Sham-laser acupuncture (n=37)	1.Reduction in SPADI 2.Reduction in VAS 3.Reduction in PGA, DGA *No reported*	1.TG>CG (P<0.001) 2.TG>CG (P<0.001) 3.TG>CG (P<0.001)

Results from the study by Garrido et al. (2016) showed a significant reduction in VAS score in the acupuncture treatment group compared to the sham acupuncture treatment group (control group).

The same outcome was found in the Kibar et al. (2017) study, where there was a significant reduction in the VAS score in the laser acupuncture treatment group compared with the sham laser acupuncture treatment (control group).

In the studies by Rueda Garrido et al., there was a significant increase in Kruskal-Wallis test scores ($P<0,05$) in the acupuncture group compared with the control group.

There were some different characteristics noted in these two studies. Garrido et al. (2016) used manual acupuncture, while Kibar et al. (2017) used laser acupuncture. Garrido et al. (2016) used 6 acupuncture points, while Kibar et al. (2017) used 11 acupuncture points. The number of treatment sessions in Kibar et al. (2017) was 9, but there were only 4 treatment sessions in Garrido et al. (2016).

There were also some similar characteristics noted in these two studies. Both studies used LI 14, LI 15, LI 16, SI 9, and TE 14 acupuncture points. Both studies did not indicate any follow-up treatment sessions. Anyhow, there was not much difference in the sample size. The sample size in Garrido et al. (2016) was 68, while it was 81 in the Kibar et al. (2017) studies.

However, both studies (Garrido et al., 2016; Kibar et al., 2017) found that there was a significant decrease in VAS score in the acupuncture treatment group compared with the control group at the end of the trials. The results showed that manual acupuncture was superior to sham acupuncture in terms of reducing shoulder pain as measured using VAS at 4-week trials (Garrido et al., 2016).

In another study, laser acupuncture was superior to sham laser acupuncture in terms of reducing shoulder pain as measured using VAS at 3-week trials (Kibar et al., 2017). The results concluded that acupuncture was more effective than sham-acupuncture ($P<0.05$) and, at the same time, laser acupuncture was more effective than sham-laser acupuncture ($P<0.05$).

Kibar et al. (2017) used Shoulder Pain and Disability Index (SPADI) indicators to evaluate pain and disability related to MSP. This study found that there was a significant reduction in SPADI in the laser acupuncture group compared to the sham-laser acupuncture group (control group). The results showed that laser acupuncture was superior to sham laser acupuncture in terms of pain and shoulder disability as measured using the SPADI score at 3 weeks of trials.

These results indicate that laser acupuncture is significantly more effective in reducing chronic shoulder pain and improving shoulder disabilities compared to sham-laser acupuncture ($P<0.001$). In the study by Kibar et al. (2017), the results showed a significant decrease in PGA and DGA in the laser acupuncture group compared with the control group.

Overall, these findings show that acupuncture treatment significantly reduces pain among patients with unilateral injuries and chronic shoulder pain when compared to sham acupuncture.

5.3.2 Acupuncture versus physical therapy

One study (Zhang et al., 2016) compared contralateral acupuncture with physical therapy. Zhang (2016) evaluated the pain intensity using VAS. The results showed that there was a significant decrease in VAS score in the acupuncture treatment group compared with the control group at the end of the trials (MD-40.9; 95% CI -49.5 to -32.3). Refer to Table 14.

Table 14: Summary of outcome measures in acupuncture versus physical therapy

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Zhang et al. (2016)	Chronic shoulder pain (Clinical)	(A) Contralateral acupuncture (n=38)	(B) Physical therapy (n=42)	1. Reduction in VAS 2. Increases in DASH score *No adverse events*	1.TG>CG Favours AC 2.TG>CG Favours AC No difference

The observation favors acupuncture treatment over physical therapy for shoulder pain reduction. Zhang (2016) evaluated shoulder functions using the DASH score. Again, acupuncture showed favorable results in increasing shoulder functions measured using DASH scores compared to physical therapy at 4-week trials as well as 16 weeks post-randomized (MD-16.1; 95% CI -2.64 to -10.6).

Even though acupuncture showed favorable results on pain reduction measured using VAS and increasing shoulder functions measured using DASH scores compared to physical therapy, the study demonstrated that there was no significant difference in the effect of acupuncture on chronic shoulder pain compared to physical therapy. Both the intervention and control groups were involved in 4-week trials.

However, there was no similarity in both treatment sessions. Contralateral acupuncture was conducted five times a week, whereas the control group underwent daily physical therapy.

5.3.3 Electroacupuncture versus exercise

One study (Chen et al., 2019) compared electroacupuncture with exercise therapy in treating RC injuries. The duration of this study was 6 weeks. The trial went on with 30 sessions of electroacupuncture treatment and 84 sessions of exercise therapy. Refer to Table 15.

Table 15: Summary of outcome measures in electroacupuncture versus exercise

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Chen et al, (2019)	RC injury	(A) Electro-acupuncture (n=20)	(B) Exercise (n=20)	1.Reductio in VAS, 2.Reduction in CMS 3.Post treatment *Not reported*	Favors EA TG>CG No difference TG=CG

Chen (2019) used the VAS indicator to evaluate the pain intensity. Constant Murley Shoulder Assessment Score (CMS) indicators were used to define the level of pain and the ability to carry out the normal daily activities of the patient. Electroacupuncture treatment showed favorable results on pain reduction measured using VAS scores compared with exercise (MD 11.55; 95% CI -3.05 to -0.04) and shoulder function improvement measured using CMS scores compared with exercise (MD 1.56; 95% CI 0.58 to 2.54).

The results show that electroacupuncture treatment is superior to exercise therapy in treating RC injuries. However, the results showed no significant difference between electroacupuncture and exercise in treating RC injuries.

5.3.4 Acupuncture versus ultrasound.

One study (Johansson et al., 2005) compared acupuncture with ultrasound treatment for shoulder impingement syndrome. Johansson (2005) used Constant Murley Shoulder Assessment Score (CMS) indicators to define the level of pain and the ability to carry out the normal daily activities of the patient. The study showed that there was a significant reduction in CMS in the acupuncture group compared with the ultrasound treatment group. Refer to Table 16.

This result indicated that there is a statistically significant effect of acupuncture over ultrasound treatment in rectifying shoulder impingement syndrome ($p = 0.045$).

Table 16: Summary of outcome measures in acupuncture versus ultrasound

Author (Year)	Condition	Intervention (TG)	Control (CG)	Outcome measures *Adverse effects*	Results
Johansson et al. (2005)	Shoulder impingement syndrome	(A) Acupuncture (n=44)	(B) Ultrasound (n=41)	1.Reduction in CMS 2.Increase in Kruskal Wallis test 3.Increase in Al-score *No adverse events*	1.TG>CG (P=0.045) 2.TG>CG (P=0.045) 3.TG>CG (P=0.045)

The Kruskal-Wallis test (UCLA Questionnaire) was used as an indicator. It is one of the shoulder assessment scales, and the maximum score is 35 points. This questionnaire contains questions such as whether the pain is constant or intermittent, whether the pain requires painkillers, whether the pain relates to rest or activities, level of activity, muscle force, and satisfaction with results. Johansson et al. (2005) showed that there was a significant increase in UCLA questionnaire scores in the acupuncture group compared with the control group.

The AL-score is one of the shoulder assessment scales, and it is a pure patient self-assessment. Johansson et al. (2005) showed a significant increase in the AL-score in the acupuncture group compared with the control group.

The study demonstrated that there was a significant difference between acupuncture treatment and ultrasound treatment at the end of a 5 week trial for shoulder impingement syndrome.

5.3.5 Acupuncture versus physical therapy and acupuncture plus physical therapy

One study (Ma et al., 2006) compared acupuncture to physical therapy and acupuncture plus physical therapy. Refer to Table 16. The study duration was 4 weeks, with 8 treatments for the acupuncture group and 20 treatments for the physical therapy group. This study

evaluated the pain intensity using VAS, shoulder function using ROM, and the performance of activities of daily living (ADL). Refer to Table 17.

Table 17: Summary of outcome measures in acupuncture versus physical therapy and acupuncture plus physical therapy

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Ma et al. (2006)	Frozen shoulder	(A) Acupuncture (n=30)	(B) Physical therapy (n=30) (C) Acupuncture + Physical therapy (n=15)	ROM, VAS, SF36 Health Survey (ADL) All groups improved in quality of life. Pain reduced in MA ROM improved more in PT	TG<CG AC + PT had the best outcome

Pain intensity was measured using the VAS. The results showed significant pain reduction in favour of the acupuncture group compared to the physical therapy group. This study also accessed the ROM. There was a significant improvement in ROM in the physical therapy group compared to the acupuncture group. In terms of shoulder functionality, the results favour the physical therapy group compared to the acupuncture group. There was much improvement in the ADL score.

The observation showed that the pain was reduced more in the acupuncture group, while ROM improved more in the physical therapy group. However, the study concluded that manual acupuncture plus physical therapy is more effective in treating FS than manual acupuncture or physical therapy alone.

5.3.6 Acupuncture plus manual therapy versus manual therapy

One study (Lu, M., 2019) compared acupuncture plus manual therapy with manual therapy. Refer to Table 18. In these studies, compared to manual therapy alone, modest benefits of acupuncture treatment plus manual therapy were observed in terms of the proportion of improved participants compared to manual therapy alone (RR 1.15; 95% CI 1.03 to 1.28).

Table 18: Summary of outcome measures in acupuncture plus manual therapy versus manual therapy

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Lu. M et al, (2019) 33	RC tear (Clinical and imaging)	(A) Manual acupuncture + Manual therapy (n=30)	(B) Manual therapy (n=30)	Function, the thickness of bilateral RC tendons, proportion of improved participants *No adverse events*	TG>CG Favours MA No difference

Despite the fact that the study favored acupuncture plus manual therapy compared to manual therapy alone, the results showed that there were no significant differences between these two groups.

5.3.7 Acupuncture plus physiotherapy versus mock TENS plus physiotherapy

In one study, Vas et al. (2008) compared acupuncture plus physiotherapy intervention with mock TENS plus physiotherapy among those patients with non-traumatic shoulder pain with a pain history of more than 3 months and a pain severity greater than a numeric rating scale (NRS) score of 4. NRS scores were used to assess levels of pain, which quantifies the current level of pain when pain-free is zero and unbearable extreme pain is ten. Refer to Table 19.

Table 19: Summary of outcome measures in acupuncture plus physiotherapy versus mock TENS plus physiotherapy

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Vas et al, (2008)	Unilateral subacromial syndromes	(A) Acupuncture + Physiotherapy	(B) Mock TENS + Physiotherapy	1.Reduction in CMS 2.Reduction in NRS *No severe events*	1.TG>CG (P<0.001) 2.TG>CG (P<0.001)

The results of this study showed a significant decrease in NRS in the acupuncture treatment group compared with the control group. The acupuncture plus physiotherapy group

showed favorable results compared with the mock TENS plus physiotherapy group. This result indicates that there is strong evidence that acupuncture plus physiotherapy is more effective than mock TENTS plus acupuncture in treating unilateral subacromial syndromes (P<0.001).

Vas et al. (2008) also used Constant Murley Shoulder Assessment Score (CMS) indicators in this study. The CMS indicators were used to define the level of pain and the ability to carry out the normal daily activities of the patient on a 100-point scale composed of a number of individual parameters. The study showed that there was a significant reduction in CMS in the acupuncture group compared with the control group. The acupuncture plus physiotherapy group showed favorable results compared with the mock TENS plus physiotherapy group. Again, this result indicates that there is strong evidence that acupuncture plus physiotherapy is more effective than mock TENTS plus acupuncture in treating unilateral subacromial syndromes (P<0.001).

5.3.8 Acupuncture plus exercise versus corticosteroid injection plus exercise

Johansson et al. (2011) compared acupuncture treatment plus exercise therapy with corticosteroid injections plus exercise therapy. Johansson et al. (2011) used VAS and the Adolfsson-Lysholm Shoulder Assessment Score (Al-score) to assess the level of pain. Refer to Table 20.

Table 20: Summary of outcome measures in acupuncture plus exercise versus corticosteroid injection plus exercise

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Johansson et al, (2011)	Shoulder impingement syndrome	(A) Acupuncture + Exercise (n=42)	(B) Corticosteroid injection + Exercise (n=49)	1.Reduction in VAS 2.Increase in Al-score *No severe events*	1.No differences 2.No differences

The results were collected from only 10 treatment sessions, which were set for a 5-week duration with 2 sessions per week. Only five acupuncture points were utilized. The study observed a significant decrease in VAS score in both the treatment group (acupuncture with exercise) and the control group (corticosteroid injections with exercise). However, the results showed that there were no significant differences between the treatment group and the control group in treating shoulder impingement syndrome.

The results clearly indicated that acupuncture is not superior to corticosteroid injection or vice versa in treating MSP. In other words, acupuncture and corticosteroid injections result in the same treatment effect for MSP.

The study by Johansson et al. (2011) showed an increase in the AL score in both the acupuncture with exercise treatment group and the corticosteroid injections with exercise control group. The results showed that the pain level was reduced significantly in both the acupuncture with exercise treatment group and the corticosteroid injections with exercise control group. However, the results showed that there were no significant differences between the treatment group and the control group. Also, the results clearly indicated that acupuncture is not superior to corticosteroid injection or vice versa in treating MSP.

Some minor adverse events were reported in the Johansson et al. (2011) study. The number of patients complaining of side effects was not reported in this study. The study reported pain, bruising, and days of worsening symptoms as signs of adverse events during the intervention. According to Johansson et al. (2011), such adverse events are common reactions following acupuncture treatments. This study, too, indicates that acupuncture is a safe treatment. The adverse events of corticosteroid injections were not mentioned in this study. Therefore, a comparison of the adverse events from both interventions could not be done.

5.3.9 Acupuncture plus AQF versus acupuncture

Shang et al. (2012) compared manual acupuncture plus accelerating Qi flow along meridians (AQF) with manual acupuncture alone. Treatments were carried out on patients with frozen shoulders while they were still in the freezing stage (stage 1). Refer to Table 21.

Table 21: Summary of outcome measures in acupuncture plus AQF versus acupuncture

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Shang et al, (2012)	Frozen shoulder	(A) Acupuncture + AQF (n=32)	(B) Acupuncture (n=32)	Cured, improved: failed ADL Pain and moving functions of shoulder and ADL improved. *Not reported*	TC>CG (P < 0.05). Statistically significant improvement in both groups. The Acupuncture + AQF group was better than Acupuncture group in all aspect

This study used less common measurement tools (ADL) to measure the intensity of pain and shoulder function. The calculation methods were not described in this study. The acupuncture plus AQF group showed favorable results compared to the acupuncture group alone. In conclusion, the study showed statistically significant improvement in both groups ($p < 0.05$), but the study indicated that the results of the acupuncture plus AQF group were better than those of the acupuncture group alone in all aspects.

Therefore, this study implies that the combination of acupuncture with AOF is more effective in treating MSP than manual acupuncture alone. There were no details of adverse events reported in this study.

5.3.10 Electroacupuncture plus rehabilitation versus electroacupuncture versus rehabilitation

Bao et al. (2012) compared electroacupuncture plus rehabilitation treatment with electroacupuncture and rehabilitation treatment. About 129 patients with post-stroke shoulder pain were involved in this study. Seven distal acupuncture points were identified for this study.

Trials were conducted once every day for 30 days. This study used FMA to compare the effects of electroacupuncture combined with rehabilitation treatment to electroacupuncture and rehabilitation treatment. Refer to Table 22.

Table: 22. Summary of outcome measures in electroacupuncture plus rehabilitation versus electroacupuncture versus rehabilitation

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Bao et al, (2012)	Poststroke sholder pain	(A) Electro acupuncture + Rehabilitation treatment (n=46)	(B) Electro Acupuncture (n=41) (C) Rehabilitation Treatment (n=42)	Improve in FMA *No adverse events*	TC>CG (P<0.001) Had a significant effect

The result showed that there was a significant improvement in the FMA score. The results indicated that combined treatment (electroacupuncture combined with rehabilitation treatment) had a significant effect in reducing post-stroke shoulder pain ($p<0.001$) compared to electroacupuncture or rehabilitation treatment alone. Bao et al. (2012) reported that no serious adverse events occurred during the trial. The reports indicated that acupuncture is a safe treatment.

5.3.11 Acupuncture plus rehabilitation versus rehabilitation

Two studies (Sheng & Shi, 2013; Ni et al., 2013) compare the effects of acupuncture combined with rehabilitation treatment to rehabilitation treatment alone for post-stroke shoulder pain. Sheng & Shi (2013) used a total of 7 acupuncture points, 6 times weekly for 4 weeks, whereas Ni et al. (2013) used ahsi points, once every day for 40 days. Refer to Table 23.

Table 23: Summary of outcome measures in acupuncture plus rehabilitation versus rehabilitation

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Sheng & Shi, (2013)	Poststroke shoulder pain	(A) Acupuncture + Rehabilitation treatment (n=33)	(B) Rehabilitation treatment (n=27)	Improve in FMA Improve in Effective rate. *Adverse events not reported*	TC>CG (P<0.001) Had a significant effect
Ni et al, (2013)	Poststroke shoulder pain	(A) Acupuncture + Rehabilitation treatment (n=32)	(B) Rehabilitation treatment (32)	VAS, FMA Decrease in VAS Improve in FMA *Adverse events not reported*	TC>CG (P<0.001) Had a significant effect

Sheng & Shi (2013) used the FMA, while Ni et al. (2013) used VAS and FMA indicators to compare the effects of acupuncture combined with rehabilitation treatment to rehabilitation treatment alone for post-stroke shoulder pain. Both studies showed significant improvements in the FMA score. Ni et al.'s (2013) study showed a significant reduction in VAS pain score. Acupuncture combined with rehabilitation treatment showed a more favorable effect on post-stroke shoulder pain recovery than rehabilitation treatment alone.

The results showed that combined treatment (acupuncture combined with rehabilitation treatment) had a significant effect on reducing post-stroke shoulder pain ($p<0.001$) compared to rehabilitation treatment alone. Sheng & Shi (2013) used the effective rate indicator for a similar comparison.

Again, the results showed that combined treatment (acupuncture combined with rehabilitation treatment) had a significant effect on reducing post-stroke shoulder pain ($p<0.001$) compared to rehabilitation treatment alone. In this study, the details about the effective rate indicator were not given.

The final results indicated that acupuncture had a significant effect on reducing post-stroke shoulder pain. Both studies did not report any adverse events from the trials.

5.3.12 Acupuncture plus rehabilitation versus acupuncture and rehabilitation

One study (Gao et al., 2012) compared acupuncture plus rehabilitation treatment versus acupuncture alone and rehabilitation treatment alone. Refer to Table 24. About 75 patients with post-stroke shoulder pain were involved in this study. Ten acupuncture points were identified for this study.

Trials were conducted six times weekly for four weeks. This study used VAS and FMA indicators to compare the effects of acupuncture combined with rehabilitation treatment to acupuncture and rehabilitation treatment.

There was a significant decrease in the VAS score and significant improvements in the FMA score.

Table 24: Summary of outcome measures in acupuncture plus rehabilitation versus acupuncture and rehabilitation

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Gao et al, (2014)	Poststroke sholder pain	(A) Acupuncture + Rehabilitation treatment (n=25)	(B) Acupuncture (n=25) (C) Rehabilitation Treatment (n=25)	VAS, FMA Decrease in VAS Improve in FMA *No adverse events*	TC>CG (P<0.001) Had a significant effect

The results showed that acupuncture combined with rehabilitation treatment was superior to acupuncture alone.

The same results showed that acupuncture combined with rehabilitation treatment is superior to rehabilitation treatment alone.

The results indicated that combined treatment (electroacupuncture combined with rehabilitation treatment) had a significant effect on reducing post-stroke shoulder pain ($p<0.001$) compared to electroacupuncture or rehabilitation treatment alone. Bao et al. (2012) reported that no serious adverse events occurred during the trial.

5.3.13 Acupuncture plus exercise versus exercise

Aris Buria et al. (2015) compared acupuncture plus exercise with exercise alone. In this study, the levels of pain were evaluated using NRS scores and the DASH Questionnaire score. Arias-Buria et al. (2015) found that both the acupuncture plus exercise group and the exercise group alone experienced a significant reduction in the NRS score. Even though there was a significant reduction in pain score in both the intervention and control groups, the results concluded that there was no significant difference between the intervention group and the control group. To assess shoulder-related disabilities, the Disabilities of the Arm, Shoulder, and Hand (DASH) Questionnaire was used. Refer to Table 25.

Table 25: Summary of outcome measures in acupuncture plus exercise versus exercise

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Arias Buria et al, (2015)	Non-traumatic shoulder in pain	(A) Acupuncture + Exercise	(B) Exercise	1.Reduction in NRS 2.Increase in DASH questionaire *No severe events*	1.No deference 2.TG>CG (P<0.01)

In the study by Arias-Buria et al. (2015), the results showed that the DASH questionnaire scores significantly improved in the acupuncture plus exercise group compared to the control group.

The results indicated that acupuncture plus exercise was superior to exercise alone in terms of shoulder disability as measured using DASH at 5-week trials. The study concluded that acupuncture treatment is more effective in improving shoulder-related disabilities than exercise therapy alone.

Arias-Bura et al. (2015) reported minor adverse events during the study. The report stated that following the first dry needling session, five patients (or 25%) who were given the exercise plus acupuncture treatment experienced muscle soreness in the particular area of acupuncture. However, according to the report, the soreness in the muscles subsided on its own within 24 to 36 hours**.**

5.3.14 Acupuncture plus physical therapy versus physical therapy

Asheghan et al. (2016) compared acupuncture plus physical therapy with physical therapy alone. Asheghan et al. (2016) examined the effect of acupuncture on active flexion range of motion (ROM). This study demonstrated that, after six weeks of treatment, acupuncture plus physical therapy was superior to physical therapy alone. In ROM, the six-week follow-up revealed that acupuncture plus physical therapy was significantly better than physical therapy alone (MD: 16.70; 95% CI: 2.85, 33.55; P 0.05). Refer to Table 26.

Table 26: Summary of outcome measures in acupuncture plus physical therapy versus physical therapy

Author (Year)	**Condition**	**Intervention (TG)**	**Control (CC)**	**Outcome measures** ***Adverse effects***	**Results**
Asheghan et al, (2016)	Frozen shoulder	(A) Acupuncture + Physical therapy (n=20)	(B) Physical therapy (n=20)	SPADI, VAS, ROM Follow-up: 1.5 months 3 months *Not reported*	In ROM TG>CG (P < 0.05) After 3 months: VAS TG>CG (P < 0.05). No difference in SPADI between the 2 groups (TG=CG)

This study found a significant relationship between acupuncture treatment and pain reduction, as indicated by the VAS score. After 3 months of follow-up study time, the results showed a significant reduction in VAS score in the acupuncture group compared to the control group (MD: -1.36; 95% CI -23, -0.430; 95% CI: 2.85, 33.55; P<0.05).

This analysis suggests that acupuncture can be useful for pain reduction in the short and midterm stages of MSP. Asheghan et al. (2016) used Shoulder Pain and Disability Index (SPADI) indicators to evaluate pain and disability related to MSP.

However, this study found that there was no significant reduction in SPADI score between the two groups. This study did not provide any safety data for all the treatments.

5.3.15 Electroacupuncture plus manual therapy versus manual therapy

One study compared electroacupuncture plus manual therapy with manual therapy alone (Shi et al., 2019). The study reported that there was a significant reduction in pain in the treatment group compared to the control group, as indicated by the ROM score (MD: -1.52; 95% CI -2.19 to -0.88). Refer to Table 27.

Table 27: Summary of outcome measures in electroacupuncture plus manual therapy versus manual therapy

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Shi et al, (2019) (34)	RC tear (Clinical and imaging)	(A) Electro acupuncture + Manual Therapy (n=52)	(B) Manual therapy (n=52)	Pain, function, ROM Post treatment *Not reported*	TG>CG Favours EA +MT Had a significant effect

The observation favors electroacupuncture plus manual therapy over manual therapy alone in pain reduction among the RC-tear patients. Therefore, it can be concluded that there was a significant effect of electroacupuncture treatment on MSP. Shi et al. (2019) did not provide any data on adverse events.

5.3.16 Electroacupuncture plus ESWT versus ESMT

One study (Lu. H., 2019) compared electroacupuncture plus extracorporeal shock wave therapy (ESWT) with ESWT alone in treating supraspinatus tendinitis. This study reported the condition of the shoulder pain, shoulder function, and proportion of improved participants after treatment using validated scales. The combination of electroacupuncture and ESWT showed favorable results for pain reduction measured using the VAS score compared with ESWT alone. There was a significant reduction in pain with electroacupuncture treatment compared to ESWT alone (MD: -1.53; 95% CI -2.19 to -0.88). In terms of shoulder function, the electroacupuncture group showed favorable results compared with the control group, as indicated by the CMS score (SMD 1.74; 95% CI 0.91 to 2.75). Refer to Table 28.

In terms of effectiveness, only modest effects of acupuncture treatment were observed in terms of the proportion of improved participants within 12 weeks compared with ESWT (RR 1.15; 95% CI 1.03 to 1.28). However, it was unclear which instruments were used in this study to evaluate the proportion of improved participants.

Table 28: Summary of outcome measures in electroacupuncture plus ESWT versus ESWT

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Lu. H, (2019) 28	Supraspinatus tendinitis (clinical)	(A) Electro acupuncture + ESWT (n=20)	(B) ESWT (n=20)	Pain, function, proportion of improved participants Post treatment *No adverse events*	TG>CG Favours EA Had a significant effect

Overall, very low certainty evidence for the short-term benefit of electroacupuncture treatment combined with ESWT was observed compared to ESWT alone in terms of pain, shoulder function, and the proportion of improved participants.

Lu. H, (2019) found no serious adverse events occurred in their study. Therefore, this study indicates that acupuncture is a safe treatment for MSP.

5.3.17 Acupuncture plus manual therapy versus manual therapy

One study compared acupuncture plus manual therapy with manual therapy alone (Lu.M., 2019). Shoulder function and the proportion of improved participants are the major outcome measures in this study. In terms of shoulder function, the acupuncture group showed favorable results compared with the control group (SMD 1.74; 95% CI 0.91 to 2.75). However, it was not clear which instruments were used to assess shoulder function. Refer to Table 29.

Table 29: Summary of outcome measures in acupuncture plus manual therapy versus manual therapy

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Lu. M, (2019) (33)	RC tear (Clinical and imaging)	(A) Acupuncture + Manual Therapy (n=30)	(B) Manual therapy (n=30)	Function, proportion of improved participants Post treatment *Not reported*	TG>CG Favor MA +MT No difference

In terms of effectiveness, only modest effects of acupuncture treatment were observed in terms of the proportion of improved participants within 12 weeks compared with manual therapy alone (RR 1.15; 95% CI 1.03 to 1.28).

Even though the study favored acupuncture plus manual therapy compared to manual therapy alone, the results showed that there were no significant differences between these two groups.

Overall, very low certainty evidence was observed for the short-term benefit of acupuncture plus manual therapy compared to manual therapy in terms of shoulder function, and the proportion of improved participants. Lu. M, (2019) found no serious adverse events occurred in their study. Therefore, this study indicates that acupuncture is a safe treatment for MSP.

5.3.18 Acupuncture plus ashi points versus ashi points

One study (Zhang et al., 2019) compared acupuncture plus ashi points with ashi points alone for frozen shoulders. This study treated patients in the frozen stage, which is considered the most difficult to treat. The intervention group and control group received the interventions once a day, six times per week. The total treatment time was 4 weeks. Follow-up at 1 and 2 months.

The intervention group used six meridian acupuncture points (all distal points), whereas the control group used ashi points. VAS indicators were used to measure the intensity of pain, and the CMS score was used to measure shoulder function. Refer to Table 30.

Table 30: Summary of outcome measures in acupuncture plus ashi points versus ashi points

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Zhang et al, (2019)	Scapulohumeral periarthritis	(A) Acupuncture + Ashi points (32)	(B) Ashi points (32)	VAS, CMS, cured, effective, or ineffective *Not reported*	TG>CG Significant improvement in the intervention group compared to the control group.

The results showed a significant reduction in pain, favoring acupuncture plus ashi points over ashi points alone.

The results showed a significant improvement in shoulder function in the acupuncture group compared to the control group. Significant improvement can be seen in both groups in post-treatment and in the follow-up treatment across all the measurements.

In conclusion, the treatment group has shown a significant improvement in all measurements and in both follow-up, times compared to the control group. Therefore, it can be concluded that there was a significant effect of acupuncture in the treatment of MSP. Zhang et al. (2019) did not report any adverse events in this study.

5.3.19 Acupuncture plus tropical NSAIDs versus ESWT plus tropical NSAIDs

One study (Chai, 2019) compared acupuncture plus tropical NSAIDs with extracorporeal shock wave therapy (ESWT) plus tropical NSAIDs.

This study compares acupuncture plus pharmacological intervention to ESWT plus pharmacological intervention, in which oral analgesics and nonsteroidal anti-inflammatory drugs are used. Refer to Table 31.

Table 31: Summary of outcome measures in acupuncture plus tropical NSAID versus ESWT plus tropical NSAID

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Chai, (2019)	Supraspinatus tendinitis	(A) Acupuncture + tropical NSAID (n=30)	(B) ESWT + tropical NSAID (n=30)	Pain VAS, Shoulder abduction ROM, proportion of improved participants *Not reported*	TG>CG Favours AC No difference

The results showed that the mean VAS score was much reduced in the intervention group compared to the control group.

Chai (2019) reports that shoulder function measurement using ROM within 12 weeks in the acupuncture group is much higher than in the control group.

Obviously, the results favor acupuncture treatments plus tropical NSAIDs more than extracorporeal shock wave therapy (ESWT) plus tropical NSAIDs.

However, the results showed that there was no significant difference between the treatment group and the control group in this study. Regarding adverse events, Chai (2019) did not provide any safety data for acupuncture and tropical NSAID treatments.

5.3.20 Electroacupuncture plus oral medication plus exercise versus oral medication plus, exercise

Papadopoulus et al. (2019) compared electroacupuncture plus oral medication plus exercise with oral medication plus exercise. Oral analgesics and non-steroidal anti-inflammatory drugs were used in this study.

In the study, the mean VAS score for shoulder pain measured at 3 weeks was 1.5 in the acupuncture group whereas 4.6 in the oral medication plus exercise group (refer to Table 32).

Table 32: Summary of outcome measures in electroacupuncture plus oral medication plus exercise versus oral medication plus exercise

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures *Adverse effects*	Results
Papadopoulus 2019	Supraspinatus calcific tendinitis	EA+ oral medication +exercise	Oral medication + exercise	Pain VAS, Shoulder abduction ROM, proportion of improved participants *Not reported*	TG>CG Favours AC No difference

This result indicated that the pain was reduced very much in the intervention group compared to the control group. Shoulder function also improved very much in the intervention group compared to the control group.

The results favor acupuncture plus oral medication plus exercise more than oral medicine plus exercise. However, the results showed that there was no significant difference between the treatment group and the control group in this study.

5.3.21 Electroacupuncture plus physical therapy versus sham-electroacupuncture plus, physical therapy

One study (Lo et al., 2020) compared electroacupuncture plus physical therapy with sham acupuncture plus physical therapy. Pain is the most common symptom of FS. This study

used VAS to measure the intensity of shoulder pain in FS. It was observed that there was a significant decrease in VAS score in the treatment group compared to the control group. This result favors electroacupuncture plus physical therapy over sham acupuncture plus physical therapy in pain reduction. This study accessed the ROM. There was a significant improvement in ROM score in the electroacupuncture plus physical therapy compared to sham acupuncture plus physical therapy. Lo et al. (2020) used Shoulder Pain and Disability Index (SPADI) indicators to evaluate pain and disability related to FS. This study found that there was a significant reduction in SPADI in electroacupuncture plus physical therapy compared to sham acupuncture plus physical therapy. Refer to Table 33.

Table 33: Summary of outcome measures in electroacupuncture plus physical therapy versus sham-electroacupuncture plus physical therapy

Author (Year)	Condition	Intervention (TG)	Control (CC)	Outcome measures Adverse effects	Results
Lo et al, (2020)	Frozen shoulder syndrome	(A) Electro acupuncture + Physical therapy (n=11)	(B) Sham Electro acupuncture + Physical therapy (n=10)	VAS, ROM, SPADI Decrease in VAS Increase in SPADI, Improvement in ROM *No adverse events*	TG>CG No significant change between the two groups in VAS, SPADI. ROM in the follow-up periods

Electroacupuncture plus physical therapy was superior to sham acupuncture plus physical therapy in terms of pain and shoulder disability as measured using the SPADI score after 6 weeks of trials.

The trial was carried out in 18 sessions, with follow-up sessions after the 18th sessions and at 1, 3, and 6 months after the 18th sessions. The study concluded that there was a significant decrease in VAS and an increase in SPANDI and ROM between baseline and the follow-up period. However, there was no significant change in VAS, SPADI, or ROM in the follow-up periods.

There was some missing data observed in this study. The study did not describe inclusion criteria for a period of less than 3 months. The standard deviation data was missing. This study, too failed to report the FS stage of treated patients. Therefore, the significance of this study cannot be verified.

Lo et al. (2020) found no serious adverse events in their study. Therefore, this study indicates that acupuncture is a safe treatment for MSP.

5.4 Research conclusion

5.4.1 Acupuncture versus Sham Acupuncture

Two studies compared acupuncture treatment with sham acupuncture (Kibar et al., 2017; Garrido et al., 2016). Both studies concluded that there was a significant reduction in VAS scores, an improvement in the Kruskal-Wallis test, a reduction in SPADI scores, and a reduction in PGA and DGA scores in the acupuncture group compared to the control groups.

Both studies showed that acupuncture treatment is more effective than sham acupuncture in terms of shoulder pain reduction and improvement in shoulder functions. In comparison, the study showed that laser acupuncture is more significant than manual acupuncture.

One study reported that no adverse events occurred during the trial (Garrido et al., 2016), whereas the other study did not provide any data on adverse events (Kibar et al., 2017). These studies concluded that acupuncture has a significant effect on the recovery of shoulder pain and shoulder functionality compared to sham acupuncture.

5.4.2 Acupuncture versus non-pharmacological interventions

Three studies compared acupuncture with non-pharmacological interventions (Zhang et al., 2016, Chen et al., 2019; and Johansson et al., 2005). Non-pharmacological interventions included in this comparison were physical therapy, exercise therapy, and ultrasound treatment.

Acupuncture treatment showed favorable results on pain reduction measured using VAS scores compared to physical therapy (Zhang et al., 2016), ultrasound treatment (Johansson et al., 2005), and exercise therapy (Chen et al., 2019).

The results showed an increase in DASH score (Zhang et al., 2016) and favorable results on shoulder function measured using CMS (Chen et al., 2019). However, two studies (Zhang et al., 2016; Chen et al., 2019) concluded that there was no significant difference between the acupuncture group and the control group (physical therapy and exercise therapy) in reducing pain and improving shoulder functions.

Anyhow, one study (Johansson et al., 2005), found that there was a significant difference in pain reduction and improvement in shoulder function in acupuncture treatment compared to ultrasound treatment.

5.4.3 Acupuncture versus non-pharmacological interventions and acupuncture plus non-pharmacological interventions

One study (Ma et al., 2006) compared acupuncture with non-pharmacological interventions and acupuncture plus non-pharmacological interventions for frozen shoulder. Non-pharmacological interventions included in this comparison included physical therapy. According to the results, both the intervention groups and control groups showed improvements in quality of life as measured by the Health Survey.

Furthermore, the results showed that pain was reduced in the acupuncture group while ROM improved in the physical therapy group. The results concluded that the control group receiving acupuncture plus physical therapy had the best outcome.

5.4.4 Acupuncture plus non-pharmacological interventions versus sham acupuncture plus, non-pharmacological interventions

One study compared electroacupuncture plus non-pharmacological interventions with sham acupuncture plus non-pharmacological interventions (Lo et al., 2020). Non-pharmacological interventions included in this comparison included physical therapy.

The initial results showed a noticeable decrease in shoulder pain measured using VAS, improvement in shoulder pain and shoulder function measured using SPADI, and improvement in shoulder function measured using ROM in both the intervention group and control group.

However, the end results showed no significant difference between the two groups in VAS scores, SPADI scores, and ROM scores in the follow-up periods.

5.4.5 Acupuncture plus non-pharmacological interventions versus non pharmacological interventions

Nine studies compared acupuncture plus non-pharmacological interventions with non-pharmacological interventions. Non-pharmacological interventions included in this comparison are manual therapy, accelerating Qi-flow along medians (AOQ), ashi points, physical therapy, rehabilitation treatment, ESWT, and exercise therapy.

Two studies focused on RC tears (Shi et al., 2019; and Lu. M et al., 2019), three studies focused on scapulohumeral periarthritis and frozen shoulder (Shang et al., 2012; Zhang et al., 2019; and Asheghan et al., 2016), two studies focused on post-stroke shoulder pain (Sheng &

Shi, 2013; Ni et al., 2013), and another two studies focused on chronic shoulder pain (Arias Buria et al., 2015; and Lu. H, 2019).

Shi et al. (2019) and Lu. M et al. (2019) studies showed that both studies favored acupuncture plus manual therapy over manual therapy alone. Shi et al. (2019) study showed that electroacupuncture plus manual therapy had a significant effect on shoulder pain reduction and shoulder function improvement. However, the Lu. M et al. (2019) study showed that acupuncture plus manual therapy had no significant effect on shoulder pain reduction shoulder function improvement when compared to manual therapy alone. Arias Buria et al. (2011), showed that acupuncture plus exercise therapy had no significant effect on shoulder pain reduction, but there was significant shoulder function improvement when compared to exercise therapy alone.

Shang et al. (2012), Zhang et al. (2019), and Asheghan et al. (2016) studies favor the acupuncture group over the control group. Shang et al. (2012) and Asheghan et al. (2016) showed that there was a statistically significant improvement in shoulder pain and shoulder function in the intervention group compared to the control group. These results showed that acupuncture treatment is effective for MSP. The Zhang et al. (2019) study showed that acupuncture plus another non-pharmacological therapy brought better results than acupuncture treatment alone in MSP.

In terms of safety, Shang et al. (2012), Zhang et al. (2019), and Asheghan et al. (2016) studies did not report any adverse events related to acupuncture or other therapies.

Lu. H. (2019) study showed that the acupuncture plus ESWT group is superior to the ESWT group. The results showed that acupuncture treatment had a significant effect on the recovery of MSP compared to the control group. In Lu. M. (2019) study, the observation

showed that the acupuncture plus exercise therapy intervention group is superior to the exercise therapy intervention group. However, the results showed that there was no significant difference between the intervention group and the control group in improving shoulder pain and shoulder function.

Sheng & Shi. (2013) and Ni et al. (2013) studies favor acupuncture plus rehabilitation therapy over rehabilitation therapy alone. Both studies reported that acupuncture plus rehabilitation therapy had a significant effect on pain reduction and shoulder function improvement in comparison to rehabilitation therapy alone.

5.4.6 Acupuncture plus non-pharmacological interventions versus non pharmacological interventions and non-pharmacological interventions

Two studies compared acupuncture plus non-pharmacological interventions with non-pharmacological interventions and another non-pharmacological intervention (Gao et al., 2014; Bao et al., 2012). Bao (2012) compared electroacupuncture plus rehabilitation treatment with electroacupuncture and rehabilitation treatment, whereas Gao (2014) compared manual acupuncture plus rehabilitation treatment with manual acupuncture and rehabilitation treatment. Non-pharmacological interventions included in this comparison are rehabilitation treatments.

Both studies showed that the acupuncture plus rehabilitation treatment groups were superior to the acupuncture group and the rehabilitation treatment group. Both studies showed significant improvements in the FMA score. Bao's (2012) study showed significant improvements in the VAS score. The observations showed that there was a significant effect of acupuncture in relieving pain and improving shoulder function among the participants in both studies.

5.4.7 Acupuncture plus non-pharmacological interventions versus the same non-pharmacological interventions plus another non-pharmacological intervention

One study (Vas et al., 2008) compared acupuncture plus physiotherapy with Mock Tens plus physiotherapy. Non-pharmacological interventions included in this study are MOCK Tens and physiotherapy. The observation showed a significant reduction in the CMS score ($p>0.001$) and a significant reduction in the NRS score ($p>0.001$). The results showed that acupuncture plus physiotherapy group is more effective than Mock Tens plus physiotherapy group.

It demonstrated that there was a significant difference between acupuncture plus physiotherapy and Mock Tens plus physiotherapy for pain relief and shoulder function improvement at the end of four weeks of treatment. These results concluded that there was a significant effect of acupuncture in reducing pain and improving shoulder function in comparison to Mock TENS plus physiotherapy at the end of the trials.

5.4.8 Acupuncture plus pharmacological interventions versus non-pharmacological interventions plus pharmacological interventions alone

One study (Chai, 2019) compared acupuncture plus tropical NSAIDs with ESWT plus tropical NSAIDs, whereas another study (Papadopoulos et al., 2019) compared electroacupuncture plus oral medication plus exercise with oral medication plus exercise.

Chai (2019) compared acupuncture plus tropical NSAIDs with extracorporeal shock wave therapy (ESWT) plus tropical NSAIDs. The results showed that the mean VAS score was much reduced in the intervention group compared to the control group. Obviously, the results favor acupuncture treatments plus tropical NSAIDs more than extracorporeal shock wave therapy (ESWT) plus tropical NSAIDs. However, the trial demonstrated that there was no significant difference between the treatment group and the control group. Both groups have similar effects on reducing pain and improving the shoulder function of the participants with MSP

5.4.9 Acupuncture plus pharmacological interventions plus non-pharmacological interventions versus pharmacological interventions plus non-pharmacological interventions

One study (Johansson et al., 2011) compared acupuncture plus exercise with corticosteroid injection plus exercise. The non-pharmacological interventions in this study were exercise therapy and corticosteroid injections. The study showed a significant reduction in the VAS score and a significant improvement in the Al-score. The observation showed that acupuncture plus exercise and corticosteroid injection plus exercise have a similar effect in terms of pain reduction and shoulder function improvement among patients suffering from shoulder impingement syndrome. However, the results showed that there were no significant differences between the acupuncture plus exercise group and the corticosteroid injections plus exercise group. These results clearly indicate that acupuncture is not superior to corticosteroid injections or vice versa in treating MSP. The outcomes showed that both acupuncture therapy and corticosteroid injections are equally effective at reducing shoulder discomfort and enhancing shoulder functionality among MSP patients.

5.4.10 Adverse Events

Thirteen studies provided information on adverse events during the acupuncture treatment for MSP (Arias Buria et al., 2015; Garrido et al., 2016; Gao et al., 2014; Bao et al., 2012; Lo et al., 2020; Lu. H et al., 2019; Lu. M et al., 2019; Zhang et al., 2016; Johansson et al., 2005; Johansson et al., 2011; Ni et al., 2013; Vas et al., 2008; and Sheng & Shi, 2013). No one reported any serious adverse events that occurred throughout the study period. Only one study (Vas et al., 2008) reported a minor adverse event. In this study, gastralgia was reported as a side effect of treatment in 3% of the acupuncture plus physiotherapy group and 5% of the mock TENS plus physiotherapy group (control group). Anyhow, the duration of this adverse

event was not mentioned in any detail. This study indicated that there are some possibilities for minor adverse events in acupuncture treatments. However, the study showed that acupuncture is still a safe treatment.

The remaining nine studies did not provide any details about adverse events in their studies (Chen et al., 2019; Kibar et al., 2017; Ma et al., 2006; Chai, 2019; Papadopoulos et al., 2019; Shi et al., 2019; Zhang et al., 2019; Asheghan et al., 2016; and Shang et al., 2012). The overall results indicated that acupuncture treatment is safe with minimal adverse events.

CHAPTER 6

DISCUSSION

This chapter discusses in detail the findings of the entire research on the effects and safety of acupuncture for the treatment of MSP. In addition, the implications for clinical practice and upcoming research are included.

6.1 Discussion of the main findings

Conditions known as musculoskeletal shoulder pain (MSP) affect the shoulder region by causing unexplained pain, stiffness, and restrictions in shoulder motion. The best method for treating MSP-related shoulder pain and regaining shoulder function is still up for debate among medical professionals due to unsuccessful treatments and the side effects of the treatments. More research into alternative treatment options is necessary because the affected individuals are still struggling with this protracted and painful condition due to a lack of a successful understanding of the cause and a successful treatment for this condition. The aim of the study is to determine two aspects: first, whether acupuncture is an effective alternative treatment for shoulder pain disorders, restoring disability and life improvement in comparison to other available treatments; and second, whether acupuncture treatment is safe without any adverse effects for shoulder pain disorders in comparison to other available treatments.

This critical narrative review identified 22 RCTs on different methods of acupuncture, including manual acupuncture, electroacupuncture, laser acupuncture, and collateral acupuncture, for the treatment of MSP. The studies compared acupuncture with sham acupuncture, pharmacologic intervention (western medication), other therapies, or treatments, and combined therapy. The studies were done with and without co-intervention. These studies

compared acupuncture with sham acupuncture, exercise therapy, ultrasound treatment, physical training, corticosteroid injection, TENS, physiotherapy, ESWT, tropical NSAIDs, manual therapy, oral medication, ashi points, and rehabilitation.

Studies comparing the effects of manual acupuncture with sham acupuncture or laser acupuncture with sham laser acupuncture for shoulder pain disorders (RC injuries and chronic shoulder pain) revealed that there was a significant reduction in pain and improvement in shoulder functions when compared to the control groups (Garrido et al., 2016; Kibar et al., 2017).

These studies demonstrated that, in terms of reducing shoulder pain and enhancing shoulder functions, acupuncture treatment is superior to sham acupuncture. In other words, these results show that acupuncture treatment is more effective than sham acupuncture. By comparison, there was a significant difference in pain reduction and shoulder functional improvement between manual acupuncture and sham acupuncture. The findings reveal that laser acupuncture is much superior to manual acupuncture in terms of effectiveness.

When comparing acupuncture treatment with ultrasound treatment (for shoulder impingement syndrome), both treatments produced positive effects in terms of pain reduction and improvement in shoulder function (Johansson et al., 2005). The results showed that there was a statistically significant difference in shoulder function and pain reduction between the acupuncture treatment and the ultrasound treatment. These studies demonstrated that, in terms of reducing shoulder pain and enhancing shoulder functions, acupuncture treatment is superior to ultrasound treatment. In other words, acupuncture treatment was better than ultrasound treatment for MSP. This finding indicates that acupuncture treatment produces better effects than ultrasound treatment.

As a conclusion, the above results showed a highly significant difference between laser acupuncture and sham laser acupuncture ($p<0.001$), a highly significant difference between manual acupuncture and ultrasound treatment ($p<0.045$), and a moderately significant difference between manual acupuncture and sham acupuncture ($p<0.05$). The above studies concluded that acupuncture treatment was much better than ultrasound treatment and sham acupuncture.

Two studies compared electroacupuncture with exercise therapy and contralateral acupuncture with physical therapy. Both studies showed a positive effect in terms of pain reduction and shoulder function improvement. Both studies favor acupuncture more than the control groups (exercise therapy and physical therapy). However, the studies found that there was no significant difference between the acupuncture group and the control group in terms of reducing shoulder pain and enhancing shoulder functions for MSP in both studies. The same results were found in post-treatment or follow-up studies. These findings demonstrated that neither the acupuncture nor the control groups were superior to one another in terms of reducing pain or enhancing shoulder function. This finding showed that patients with MSP experienced the same pain reduction and shoulder function improvement benefits in both the acupuncture and control groups. These results indicate that acupuncture treatment is equally effective as exercise therapy and physical therapy for MSP. In other words, acupuncture treatment can produce the same positive effects as exercise therapy and physical therapy in reducing pain and improving shoulder function among MSP patients.

When comparing a study involving acupuncture treatment with physical therapy and acupuncture treatment plus physical therapy (combined intervention) for frozen shoulder (Ma et al., 2006), the results were more in favor of the control group (acupuncture plus physical therapy) than the treatment group. According to the study, all three groups showed great

improvement in their quality of life. However, a better reduction in shoulder pain was seen in the acupuncture group, and ROM improvement was seen in the physical therapy group. This observation showed that acupuncture treatment plus physical therapy had the best outcome. This result indicated that acupuncture treatment combined with physical therapy produced better effects than acupuncture treatment alone or physical therapy alone. The results demonstrated that a coordinated multidisciplinary pain management approach is needed for MSP.

Nine studies compared acupuncture plus non-pharmacological interventions with non-pharmacological interventions alone. Non-pharmacological interventions included in this comparison are manual therapy, accelerating Qi-flow along medians (AOQ), ashi points, physical therapy, rehabilitation treatment, and exercise therapy.

When comparing acupuncture treatment plus exercise therapy with exercise therapy alone for non-traumatic shoulder pain (Arias Buria et al., 2015), the results showed that there was a noticeable reduction in the shoulder pain score (NRS) and an improvement in shoulder function (DASH score) in both groups. However, the result found no significant difference between acupuncture treatment plus exercise therapy and exercise therapy alone in terms of reduction in shoulder pain, but there was a statistically significant difference ($p<0.01$) between the acupuncture treatment plus exercise therapy group and the exercise therapy group in terms of shoulder function improvement. This result indicates that acupuncture treatment helps in pain reduction, whereas exercise therapy helps in improving shoulder function.

One study comparing acupuncture treatment plus physical training with physical training alone (Asheghan et al., 2016) showed that in ROM, acupuncture treatment plus physical training was more effective than physical training alone ($P<0.05$). There was a significant reduction in pain in the acupuncture treatment plus physical training group

compared to the physical training group. Again, this result showed that combined treatment brings better results.

This result was maintained throughout the follow-up period of 45 days to three months. The study revealed that there was significant pain reduction and shoulder function improvement in the acupuncture group. The analysis suggests that acupuncture can be useful for pain reduction in the short and medium terms. Hence, this study has proven that a significant improvement can be seen in MSP patients using acupuncture.

When comparing acupuncture treatment plus manual therapy with manual therapy alone (Shi et al., 2019), the results were the same as in the study comparing acupuncture treatment plus exercise therapy with exercise therapy for non-traumatic shoulder pain. It should be noted that this study used different outcome measures compared to other studies. The study indicated that there were modest benefits of acupuncture treatment in term of the proportion of improved participants compared with manual therapy.

Hence, the study favors acupuncture rather than manual therapy. However, there was no statistically significant difference between acupuncture treatment plus manual therapy and manual therapy in terms of pain reduction and shoulder function. This result indicated that the effect of acupuncture treatment plus manual therapy was slightly better than manual therapy alone. In other words, acupuncture treatment produces the same therapeutic effect as manual therapy. Hence, these results suggest that acupuncture treatment can replace manual therapy for MSP recovery.

The results of the acupuncture intervention plus accelerating Qi-flow along medians (AOF) versus acupuncture intervention alone for frozen shoulder (Shang et al., 2012) showed that shoulder pain and shoulder movement function improved in both groups. The results showed that there was statistically significant improvement in both the intervention and control

groups ($p<0.05$). The study also showed that acupuncture or AOF alone can bring significant improvement to MSP. However, the study found that combined interventions (acupuncture plus AOF) produced far greater results than acupuncture alone. This finding again suggests that combined acupuncture treatments produce a better outcome in treating MSP.

Another study comparing acupuncture treatment plus ashi point with ashi point alone (Zhang et al., 2019) showed positive results in VAS, CMS, and HAMA indicators. In comparison to baseline, both groups showed a significant improvement across all measurements during the post-treatment and follow-up periods. Although the study favors acupuncture rather than ashi point stimulation. The treatment group has significantly improved in all measurements and in both follow-up, times compared to the control group. The study found significant improvement in shoulder function and pain reduction in both groups.

This result indicates that both acupuncture treatment plus ashi points stimulation and ashi points stimulation alone can produce the same recovery effects for MSP. Again, this result supports the previous findings that combined acupuncture therapy is much more effective than other therapies.

Two studies compared acupuncture treatment plus rehabilitation with rehabilitation therapy alone (Shen and Shi, 2013; and Ni et al., 2013). Both studies favor acupuncture treatment plus rehabilitation over rehabilitation therapy alone in terms of shoulder pain reduction and shoulder function improvement. Both studies showed strong statistical significance in pain reduction and shoulder function improvement in the acupuncture treatment plus rehabilitation group compared to the rehabilitation group ($P<0.001$). This analysis indicated that acupuncture treatment plus rehabilitation had significant therapeutic effects on MSP. Again, this result supports the previous findings that combined acupuncture interventions is much more effective than single therapies.

Two studies compared acupuncture plus non-pharmacological interventions with non-pharmacological interventions and another non-pharmacological intervention (Gao et al., 2014; and Bao et al., 2012). The studies compared acupuncture treatment plus rehabilitation with rehabilitation alone and acupuncture alone. Both studies showed that the acupuncture group was superior to the control group. Both studies showed significant improvements in shoulder function. One study showed significant improvements in shoulder pain reduction. Once again, the observations showed that there was a significant effect of acupuncture in relieving pain and improving shoulder function among the participants with MSP in both studies.

Another study compared acupuncture plus physiotherapy with Mock Tens plus physiotherapy (Vas et al., 2008). The observation showed a significant improvement in shoulder function ($p<0.001$) and a significant reduction in shoulder pain ($p<0.001$) in the acupuncture treatment group compared to the control group. It demonstrated that there was a significant difference between acupuncture plus physiotherapy and Mock Tens plus physiotherapy for pain relief and shoulder function improvement at the end of four weeks of treatment. The analysis indicated that the acupuncture plus physiotherapy group was more effective than the Mock Tens plus physiotherapy group in terms of shoulder pain reduction and shoulder function improvement. The combined treatment showed that acupuncture treatment helped in pain reduction and physiotherapy helped improved shoulder function.

Three studies compared acupuncture plus pharmacological interventions with non-pharmacological interventions plus pharmacological interventions. The first study was acupuncture plus tropical NSAIDs compared to ESWT plus tropical NSAIDs by Chai (2019). The second study (Papadopoulos et al., 2019) compared electroacupuncture plus oral medication plus exercise with oral medication plus exercise. The third study compared acupuncture plus exercise with corticosteroid injection plus exercise (Johansson et al., 2011).

The results showed that the pain level was reduced in the intervention group compared to the control group in both studies.

Obviously, the results favor acupuncture treatments plus pharmacological interventions more than non-pharmacological interventions plus pharmacological interventions. However, the studies demonstrated that there was no significant difference between the treatment groups and the control groups. According to the study, both groups had similar effects on reducing pain and improving shoulder function for the participants with MSP. This finding indicates that acupuncture treatment alone can produce the same therapeutic effect for shoulder pain and shoulder function recovery as pharmacological interventions such as tropical NSAIDs, oral medicine, and corticosteroid injections.

Since the usage of diclofenac gel, prednisolone, or triamcinolone, oral medicine such as oral analgesics and non-steroidal anti-inflammatory drugs, and corticosteroid injections such as hydrocortisone, triamcinolone, and methylprednisolone come with some adverse events, these medications should be used with more caution in clinical setting. Therefore, in such a case, the best option is to replace the use of pharmacological interventions for MSP in this situation is acupuncture, which is safe, effective, and free of any serious adverse events.

The overall findings showed that out of twenty-two studies, eleven found that acupuncture treatment had significantly greater effects when compared with other therapies or treatments. Of the eleven studies, three showed that acupuncture treatment alone was more effective than sham acupuncture and ultrasound treatment for relieving pain and improving shoulder function at the end of the treatment period. Nine studies showed that, when combined with other therapies or treatments, the acupuncture group showed a better therapeutic effect than the therapy group itself (physical therapy, physiotherapy, ashi points, and rehabilitation).

The result clearly indicated that combined treatment had a significant effect greater than single treatment.

Despite the fact that almost all the trials in these included studies were in favor of acupuncture treatment compared to the other treatments or therapies, eleven studies showed that there was no significant difference between the effects of acupuncture treatment as a lone treatment or combined treatment when compared to exercise therapy, physical therapy, manual therapy, ESWT, tropical NSAIDs, corticosteroid injections, and oral medication. These findings suggest that acupuncture treatment has the same therapeutic effects as other treatments or therapies such as exercise therapy, physical therapy, manual therapy, ESWT, tropical NSAIDs, corticosteroid injections, and oral medication are effective in reducing pain and improving shoulder function. Therefore, these results indicate that acupuncture treatment can be an optional treatment for the aforementioned therapies.

However, no studies have shown that acupuncture is ineffective in improving the shoulder condition in MSP when compared to other therapies or other medical interventions. Hence, the research hypotheses ($H1_1$) were accepted and the null hypotheses ($H1_0$) were rejected.

Inflammation and pain are caused by poor blood flow to the shoulder joint and a deficiency of fluid in the shoulder bursa (Chang, 2004; Seyam et al., 2018). The use of acupuncture enables regular stimulation of the acupoints, which enhances blood flow to the shoulder area, improves nutrient absorption, and lessens pain perception. Furthermore, acupuncture is likely capable of enhancing the endogenous opioid system in the body, which can lessen pain perception. Acupuncture contributes to the analgesic effect by activating opioid receptors and increasing the expression of endorphin in tissue.

The use of distal acupuncture points and local acupuncture points plays an important role in activating the acupuncture therapeutic ability and generating beneficial effects. Distal acupuncture showed an immediate increase in the ROM and an immediate reduction of pain in the VAS score, whereas local acupuncture points can improve blood circulation in the shoulder and help with pain reduction (Matsubara et al., 2010).

The included studies did not report any serious adverse events. Twelve studies provided information on adverse events during acupuncture treatment for various kinds of shoulder pain (Gao et al., 2014; Ni et al., 2013; Bao et al., 2012; Lo et al., 2020; Lu. H et al., 2019; Lu. M et al., 2019; Zhang et al., 2016; Johansson et al., 2005; Sheng & Shi, 2013; Gao et al., 2014; Ni et al., 2013; and Bao et al., 2012). Headaches, dizziness, loss of strength in the leg, worsening symptoms of pain over several days, and an inflammatory response are a few of the short-term adverse events of acupuncture reported in several studies. However, none of the twelve studies reported any serious adverse events that occurred throughout the study period.

Only one study (Vas et al., 2008) reported minor adverse events in their trials. In this study, gastralgia was reported as a side effect of treatment in 3% of the acupuncture plus physiotherapy group and 5% of the mock TENS plus physiotherapy group (control group). However, the duration of this adverse event was not mentioned in any detail. This study indicated that there are some possibilities for minor adverse events in acupuncture treatments. However, the study demonstrated that acupuncture is still a safe treatment.

The remaining nine studies did not provide any details about adverse events in their studies (Chen et al., 2019; Kibar et al., 2017; Ma et al., 2006; Chai, 2019; Papadopoulos et al., 2019; Shi et al., 2019; Zhang et al., 2019; Shang et al., 2012; and Asheghan et al., 2016). Although incomplete reporting of safety data was prevalent in the included studies, it can be concluded that the majority of the studies demonstrated that acupuncture treatment is a safe

treatment. If there were any adverse events, they were probably only minor, short-term negative outcomes.

The critical analysis concluded that acupuncture is a safe treatment. Hence, the research hypotheses ($H2_1$) were accepted and the null hypotheses ($H2_0$) were rejected.

6.2 Overall completeness and applicability of the evidence

Contemporary electroacupuncture, conventional Chinese manual acupuncture, laser acupuncture, and collateral acupuncture were used in the current study for treating adult patients with MSP. Patients from outpatient clinics made up the majority of the participants in the included studies. Twelve of the 22 studies were carried out and published in China, and the results of these studies might not be generalizable to other contexts. The types of acupuncture and control interventions, the outcome measures, and some clinical characteristics, such as the condition, severity, and length of symptoms prior to the trial, were heterogeneous.

As a result, the findings of this study may only offer a generalized understanding of the evidence supporting acupuncture's use in treating MSP. Future studies may be necessary to evaluate the evidence supporting particular forms of acupuncture, such as non-penetrating laser acupuncture, trigger point acupuncture, and ashi point acupuncture.

Although the acupuncture prescriptions used in the included studies varied, some acupuncture points were frequently used in the trials. The acupuncture points LI 14 (Binao), LI 15 (Jianyu), and TE 14 (Jianliao) were most frequently used in these studies. Those points are located in key positions around the shoulder area, such as the anterosuperior joint capsule areas, the coracohumeral ligament areas, and the rotator cuff interval areas. Those local points improve blood circulation in the shoulder and reduce pain (Ben-Arie et al., 2020).

These acupuncture points are frequently used to relieve pain, promote Qi movement, release blood stasis, and expel wind in clinical settings. The results of this critical analysis suggested that both EA and MA at local and distal acupuncture points can activate the acupoint's therapeutic ability and generate this beneficial effect. While local point acupuncture helps to improve blood circulation and reduce shoulder pain, distal point acupuncture shows an immediate increase in shoulder movement and pain reduction. The most common meridian types used are: large intestine, triple burner, small intestine, and stomach.

As the results of this review do not provide sufficient evidence for the effectiveness of combined interventions like acupuncture plus cupping therapy, moxibustion, acupressure, tuina, or herbal medicine, the evidence may only be partially or limitedly applicable in many Asian countries where these types of combined treatments are frequently used in clinics and health centers.

The majority of studies have concentrated on primary and secondary outcomes like pain relief, shoulder function, and, in some cases, quality of life improvement. However, some of the studies' insufficient reporting on the safety of acupuncture precluded a thorough analysis of the adverse events of acupuncture.

Results from the current studies generally reflect the most recent approaches to treating MSP. Treatment with acupuncture appears to be effective for MSP. Additionally, it appears to be considerably safer than the other therapeutic approaches, both pharmaceutical and non-pharmacological. The critical narrative review concluded that acupuncture is a safe treatment.

Acupuncture, however, appears to have some potential effects for improving ROM, shoulder function, and pain reduction. The development of an ideal treatment regimen, however, has been hampered by a number of confounding factors, including age, gender,

sample size, number of acupuncture points, duration of treatment, ideal treatment regime, and low study quality.

6.3 Limitations

The limitation of this study was that the number of RCT studies selected was small, of poor quality, and had methodological shortcomings. The current study only searches English-language electronic databases to identify potential studies published in English due to language barriers and limited access to databases developed in other languages. Therefore, the papers published in other languages such as Chinese, Japanese, Korean, German, or Spanish may have been missed. In addition, the present study did not include non-RCTs and incorporated unpublished data, which may result in the loss of important information in the field. Some of the studies were unable to provide a valid measurement technique. Several studies, particularly from China, used less common measurement tools such as "Effective rate" where the calculation method was not fully described. Only 2 studies, out of 22 studies included, compared the acupuncture group to a sham acupuncture group in order to eliminate the placebo effect (Kibar et al., 2017; and Garrido et al., 2016). The wide range of measurement methods used in MSP studies makes it much more challenging to draw a firm conclusion from the critical analysis. Treatment duration for most of the studies was 1-4 weeks, and it did not continue with follow-up. The follow-up time of 1 year should stand as the standard follow-up for MSP due to its long recovery time without treatment of 1-4 years (Wong et al., 2017).

CHAPTER 7

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter summarises and wraps up the entire study on the efficacy and safety of acupuncture treatment for musculoskeletal shoulder pain (MSP). There were also recommendations, along with implications for clinical research, and future research.

7.1 Summary of the main findings

This study investigated and evaluated the efficacy and safety of acupuncture treatment for shoulder pain disorders in adult patients with MSP by critically reviewing 22 RCTs involving 1,808 participants. The majority of studies compared acupuncture either alone, in combination with active comparators, or with an active comparator alone, indicating that the current body of evidence has been primarily concerned with assessing the additive effects or comparative efficacy of acupuncture in comparison to other interventions.

In this study, acupuncture was shown to be a safe treatment with significant effects in regards to reducing pain and improving shoulder function in the short and medium terms. However, there is no evidence to support the use of acupuncture for long-term outcomes in patients with MSP, as all trials reported short-term results, and roughly half provided intermediate-term results.

Overall, acupuncture's short-term advantages were found to have some certainty of evidence when compared to the same active comparison when used alone or in combination. Even though there was a high prevalence of incomplete reporting of safety data in the studies included in this review, the reported adverse events were minor and infrequent.

Although there is some evidence for the effect of acupuncture treatment on shoulder pain disorders, the results are not conclusive. The results need to be interpreted with great caution due to numerous confounding variables and substantial unexplained heterogeneity.

7.2 Implications for Clinical Practice

Based on the findings from the RCTs, short-term benefits of acupuncture treatment for MSP were observed. When applying acupuncture alone or as an adjunct therapy to ultrasound, physical training, physiotherapy, ashi points, AOF, and rehabilitation, acupuncture might benefit the treatment of MSP. Most studies compared acupuncture either alone or in combination with active comparators or with active comparators alone. Most trials reported short-term outcomes, and almost half provided intermediate-term outcomes. The preliminary findings support the benefits of acupuncture in terms of pain reduction and shoulder function.

The long-term effects of acupuncture on MSP were not investigated in this study. Therefore, whether acupuncture can yield a long-term improvement in shoulder pain and shoulder function in patients with MSP remains unclear. There were numerous confounding variables, such as age range, sample size, number of acupuncture points, duration of treatment, ideal treatment regime, and types of acupuncture.

Therefore, any regimen of intervention or an ideal standardized regime cannot be endorsed for this current study. As the overall quality of the included studies was low, the current findings need to be confirmed in well-designed RCTs in the future.

7.3 Implications for Future Research

Age, gender, the severity or condition of the case, the types of interventions, and withdrawals or drop-outs, along with the reasons, should all be clearly recorded and reported.

Age and gender factors should be considered (Hermoso & Calvo, 2009). Essential information on specific acupuncture points, types of needles, insertion depth, insertion angle, “deqi” sensation, needle manipulation techniques, retention time, length of the treatment, follow-ups, and sham acupuncture must be provided in detail. In the future, high-quality RCTs in a variety of settings should be conducted with the statistical power to produce significant results. Validated instruments or indicators for outcome measures should be used to assess the efficacy of the intervention. Evidence is required to support acupuncture's benefits for long-term healing, quality of life, and patient satisfaction. Every adverse event should be recorded and clearly reported. It should be noted that information about the interventions' safety needs to be reported explicitly.

7.4 Conclusion and recommendation

One of the most common musculoskeletal pains in society is shoulder pain. Pharmacotherapy, physiotherapy, and exercise are some of the traditional treatments for this condition. However, people find that these options are unsatisfactory, so they tend to turn to complementary and alternative medicine, including acupuncture, for solutions.

Acupuncture is increasingly used as a non-pharmacological treatment for MSP. Acupuncture has been shown to relieve pain by promoting energy (Qi) or blood circulation, blocking pain signals through chronic pain-carrying nerves and other pain nerves, and releasing pain-relieving chemicals.

In this critical narrative review, acupuncture was shown to be a safe treatment with a significant effect regarding reducing shoulder pain, improving shoulder function, and overall increasing the quality of life. Therefore, acupuncture may be an effective and safe treatment for MSP.

However, very low-certainty evidence for the short-term benefit of acupuncture alone or acupuncture combined with other active treatments was observed compared with other active treatments. The reported benefits should be interpreted with great caution because of the small number of included studies, small sample size, methodological limitations, incomplete reporting, and unexplained substantial heterogeneity. In order to draw a robust conclusion, larger-scale, and high-quality RCTs are needed to determine the effectiveness and safety of acupuncture treatment for MSP.

Future studies should compare acupuncture to other popular alternative treatments such as cupping therapy, moxibustion, herbal medicine, chiropractic, acupressure, arthroscopic capsular release, hydrodilatation, and manipulation under anesthesia. A larger sample size and a more rigorous study design are needed to determine the role of acupuncture in the treatment of MSP. Longer follow-up times are also required to investigate the effects of acupuncture in the medium and long term. The duration of future MSP study follow-up should be increased to one year. Since a large variety of measurement tools in MSP studies implicate the homogeneity of the results, it is recommended to use reliable tools and measurement scales such as the Visual Analogue Scale (VAS), Constant-Murley Score (CMS), ROM, Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH) questionnaire, the Shoulder Pain and Disability Index (SPADI), the University of California-Los Angeles (UCLA) shoulder scale, and the Fugl–Meyer assessment-upper extremity (FMA-UE) scale.

Further clinical studies involving acupuncture must use an optimal form of treatment. Through rigorous designs, reasonable evaluations, and critical narrative reviews, it is possible to arrive at a more robust conclusion on the efficacy and safety of acupuncture treatment for musculoskeletal shoulder pain.

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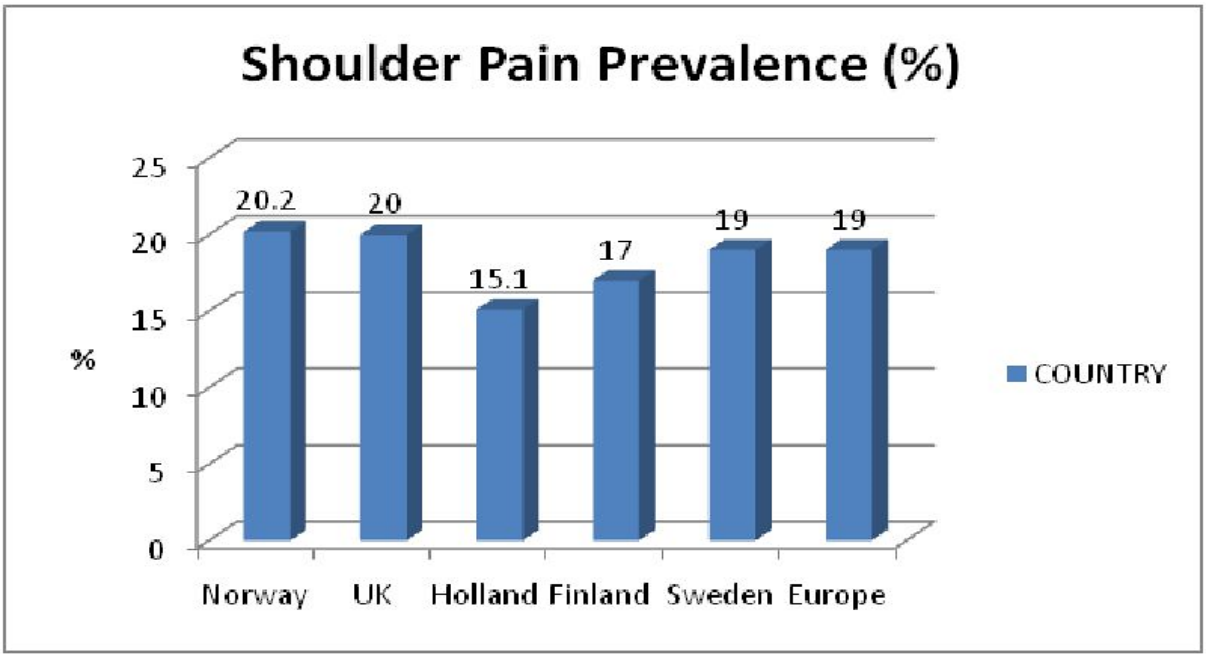
Appendix

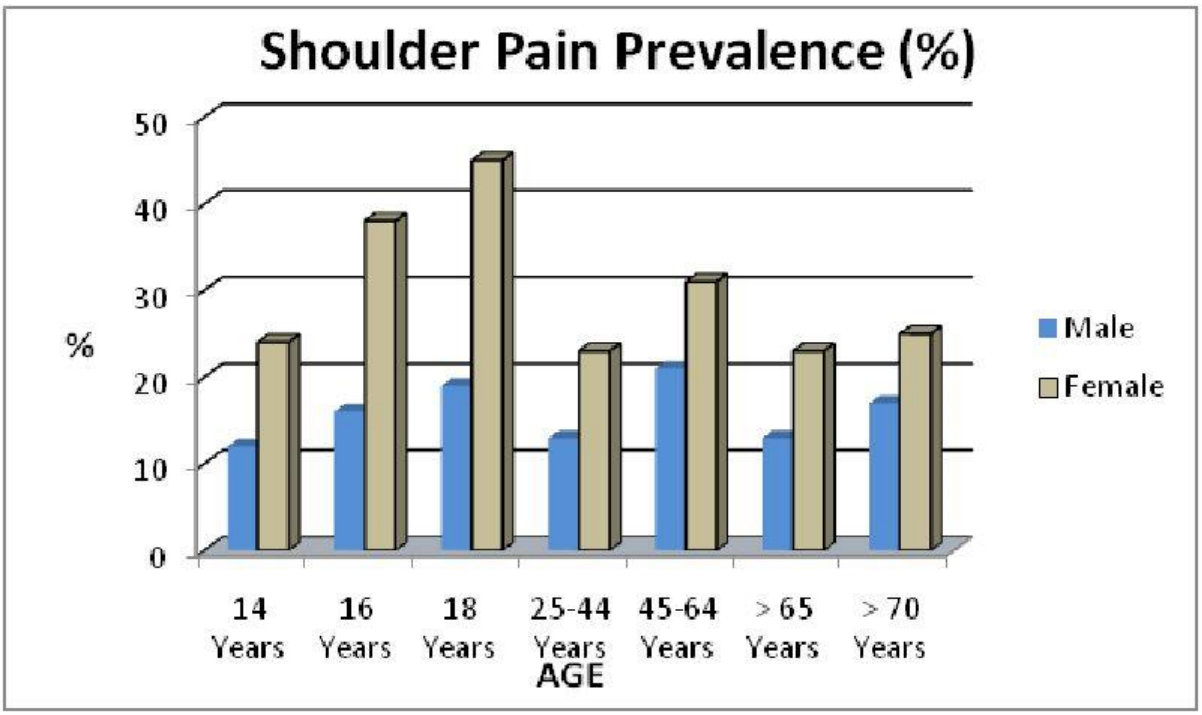
Appendix 1

Sample of the prevalence of shoulder pain in general population by country



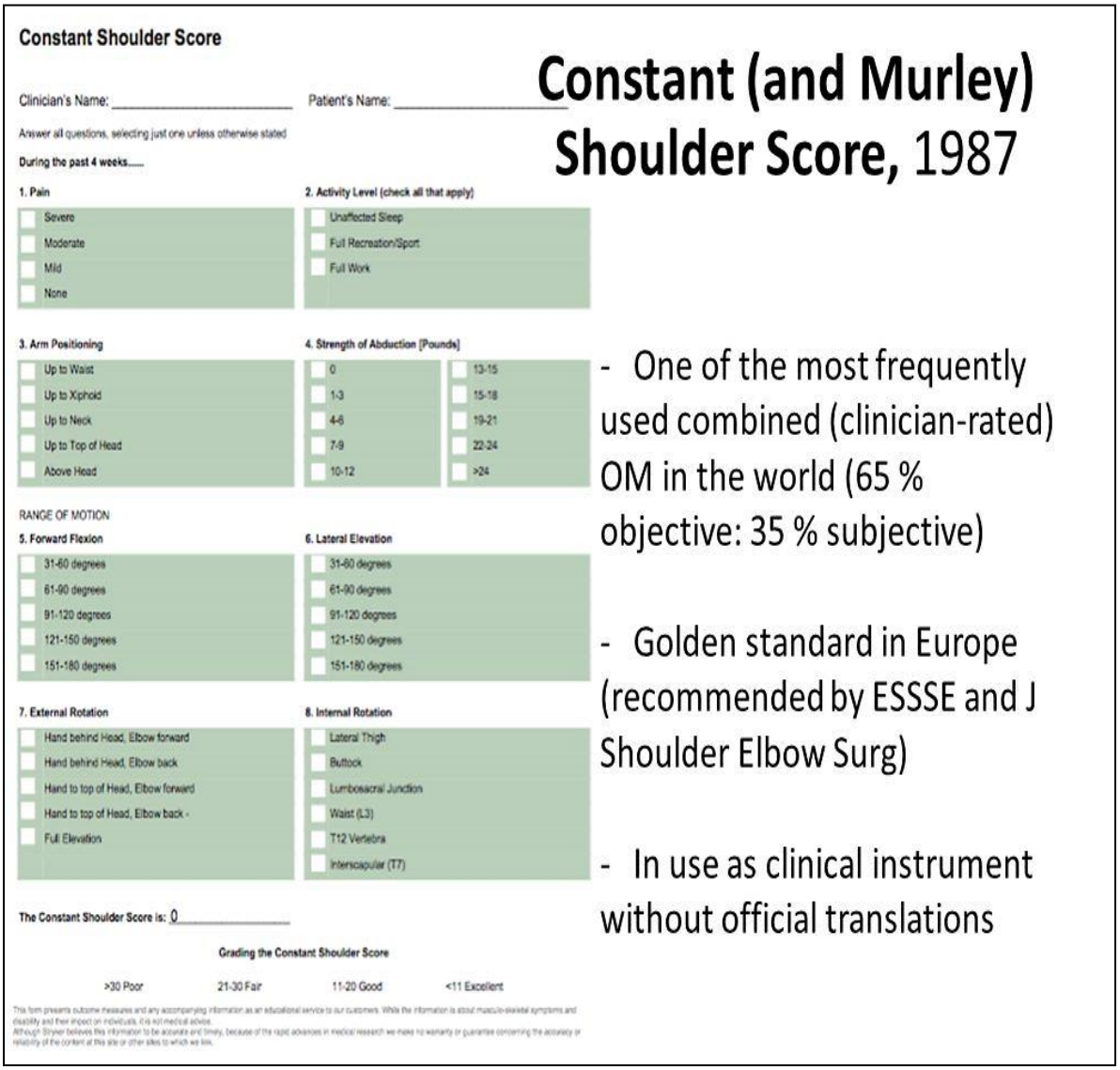
Appendix 2

Sample of the prevalence of shoulder pain in general population by gender



Appendix 3

A sample of Constant-Murley Score (CMS) sheet



Constant Shoulder Score

Clinician's Name: _____ Patient's Name: _____

Answer all questions, selecting just one unless otherwise stated

During the past 4 weeks.....

1. Pain

- Severe
- Moderate
- Mild
- None

2. Activity Level (check all that apply)

- Unaffected Sleep
- Full Recreation/Sport
- Full Work

3. Arm Positioning

- Up to Waist
- Up to Xiphoid
- Up to Neck
- Up to Top of Head
- Above Head

4. Strength of Abduction [Pounds]

- 0
- 1-3
- 4-6
- 7-9
- 10-12
- 13-15
- 15-18
- 19-21
- 22-24
- >24

RANGE OF MOTION

5. Forward Flexion

- 31-60 degrees
- 61-90 degrees
- 91-120 degrees
- 121-150 degrees
- 151-180 degrees

6. Lateral Elevation

- 31-60 degrees
- 61-90 degrees
- 91-120 degrees
- 121-150 degrees
- 151-180 degrees

7. External Rotation

- Hand behind Head, Elbow forward
- Hand behind Head, Elbow back
- Hand to top of Head, Elbow forward
- Hand to top of Head, Elbow back -
- Full Elevation

8. Internal Rotation

- Lateral Thigh
- Buttock
- Lumbosacral Junction
- Waist (L3)
- T12 Vertebra
- Interscapular (T7)

The Constant Shoulder Score is: 0

Grading the Constant Shoulder Score

>30 Poor 21-30 Fair 11-20 Good <11 Excellent

This form presents outcome measures and any accompanying information as an educational service to our customers. While the information is about musculo-skeletal symptoms and disability and their impact on individuals, it is not medical advice.
Although Stryker believes this information to be accurate and timely, because of the rapid advances in medical research we make no warranty or guarantee concerning the accuracy or reliability of the content at this site or other sites to which we link.

Constant (and Murley) Shoulder Score, 1987

- One of the most frequently used combined (clinician-rated) OM in the world (65 % objective: 35 % subjective)

- Golden standard in Europe (recommended by ESSSE and J Shoulder Elbow Surg)

- In use as clinical instrument without official translations

Appendix 4

A sample of Fugl-Meyer Assessment (Upper Extremity)

FUGL-MEYER ASSESSMENT ID:
UPPER EXTREMITY (FMA-UE) Date:
Assessment of sensorimotor function Examiner:

Fugl-Meyer AR, Jaasko L, Leyman I, Olsson S, Steglind S: The post-stroke hemiplegic patient. A method for evaluation of physical performance. Scand J Rehabil Med 1975, 7:13-31.

A. UPPER EXTREMITY, sitting position				
I. Reflex activity		**none**	**can be elicited**	
Flexors: biceps and finger flexors (at least one) **Extensors**: triceps		0 0	2 2	
Subtotal I (max 4)				
II. Volitional movement within synergies, without gravitational help		**none**	**partial**	**full**
Flexor synergy: Hand from contralateral knee to ipsilateral ear. From extensor synergy (shoulder adduction/ internal rotation, elbow extension, forearm pronation) to flexorsynergy (shoulder abduction/ externalrotation, elbow flexion, forearm supination). **Extensor synergy:** Hand from ipsilateral ear to the contralateral knee	Shoulder retraction elevation abduction (90°) external rotation Elbow flexion Forearm supination	0 0 0 0 0 0	1 1 1 1 1 1	2 2 2 2 2 2
	Shoulder adduction/internal rotationElbow extension Forearm pronation	0 0 0	1 1 1	2 2 2
Subtotal II (max 18)				
III. Volitional movement mixing synergies, without compensation		**none**	**partial**	**full**
Hand to lumbar spine hand on lap	cannot perform or hand in front of ant-sup iliac spine hand behind ant-sup iliac spine (without compensation) hand to lumbar spine (without compensation)	0	1	2
Shoulder flexion 0°- 90° elbow at 0° pronation-supination 0°	immediate abduction or elbow flexion abduction or elbow flexion during movement flexion 90°, no shoulder abduction or elbow flexion	0	1	2
Pronation-supination elbow at 90° shoulder at 0°	no pronation/supination, starting position impossible limited pronation/supination, maintains starting positionfull pronation/supination, maintains starting position	0	1	2
Subtotal III (max 6)				
IV. Volitional movement with little or no synergy		none	partial	full
Shoulder abduction 0 - 90° elbow at 0° forearm pronated	immediate supination or elbow flexion supination or elbow flexion during movement abduction 90°, maintains extension and pronation	0	1	2
Shoulder flexion 90° - 180° elbow at 0° pronation-supination 0°	immediate abduction or elbow flexion abduction or elbow flexion during movement flexion 180°, no shoulder abduction or elbow flexion	0	1	2
Pronation/supination elbow at 0° shoulder at 30°- 90° flexion	no pronation/supination, starting position impossible limited pronation/supination, maintains start positionfull pronation/supination, maintains starting position	0	1	2

		Subtotal IV (max 6)		
B. WRIST support may be provided at the elbow to take or hold the startingposition, no support at wrist, check the passive range of motion prior testing		**none**	**partial**	**full**
Stability at 15° dorsiflexion elbow at 90°, forearm pronatedshoulder at 0°	less than 15° active dorsiflexion dorsiflexion 15°, no resistance tolerated maintains dorsiflexion against resistance	0	1	2
Repeated dorsifexion / volar flexion elbow at 90°, forearm pronated shoulder at 0°, slight finger flexion	cannot perform volitionally limited active range of motion full active range of motion, smoothly	0	1	2
Stability at 15° dorsiflexion elbow at 0°, forearm pronated slight shoulder flexion/abduction	less than 15° active dorsiflexion dorsiflexion 15°, no resistance tolerated maintains dorsiflexion against resistance	0	1	2
Repeated dorsifexion / volar flexion elbow at 0°, forearm pronated slight shoulder flexion/abduction	cannot perform volitionally limited active range of motion full active range of motion, smoothly	0	1	2
Circumduction elbow at 90°, forearm pronatedshoulder at 0°	cannot perform volitionally jerky movement or incomplete complete and smooth circumduction	0	1	2
	Total B (max 10)			

C. HAND support may be provided at the elbow to keep 90° flexion, no support atthe wrist, compare with unaffected hand, the objects are interposed, active grasp		**none**	**partial**	**full**
Mass flexion from full active or passive extension		0	1	2
Mass extension from full active or passive flexion		0	1	2
GRASP				
a. Hook grasp flexion in PIP and DIP (digits II-V),extension in MCP II-V	cannot be performed can hold position but weak maintains position against resistance	0	1	2
b. Thumb adduction 1-st CMC, MCP, IP at 0°, scrap of paperbetween thumb and 2-nd MCP joint	cannot be performed can hold paper but not against tugcan hold paper against a tug	0	1	2
c. Pincer grasp, opposition pulpa of the thumb against the pulpa of2-nd finger, pencil, tug upward	cannot be performed can hold pencil but not against tugcan hold pencil against a tug	0	1	2
d. Cylinder grasp cylinder shaped object (small can) tug upward, opposition of thumb andfingers	cannot be performed can hold cylinder but not against tug can hold cylinder against a tug	0	1	2
e. Spherical grasp fingers in abduction/flexion, thumbopposed, tennis ball, tug away	cannot be performed can hold ball but not against tugcan hold ball against a tug	0	1	2
	Total C (max 14)			

D. COORDINATION/SPEED, sitting, after one trial with both arms, eyesclosed, tip of the index finger from knee to nose, 5 times as fast as possible		**marked**	**slight**	**none**
Tremor	at least 1 completed movement	0	1	2

Dysmetria at least 1 completed movement	pronounced or unsystematicslight and systematic no dysmetria	0	1	2
		≥ 6s	2 - 5s	< 2s
Time start and end with thehand on the knee	at least 6 seconds slower than unaffected side2-5 seconds slower than unaffected side less than 2 seconds difference	0	1	2
	Total D (max 6)			
	TOTAL A-D (max 66)			

H. SENSATION, upper extremity eyes closed, compared with the unaffected side		**anesthesia**	**ypoesthesia or dysesthesia**	**normal**
Light touch	upper arm, forearm palmary surface of the hand	0 0	1 1	2 2
		less than 3/4correct or absence	3/4 correct or considerable difference	correct 100%,little or no difference
Position small alterations in theposition	shoulderelbow wrist thumb (IP-joint)	0 0 0 0	1 1 1 1	2 2 2 2
Total H (max12)				

J. PASSIVE JOINT MOTION, upper extremity,sitting position, compare with the unaffected side				J. JOINT PAIN during passivemotion, upper extremity		
	only fewdegrees (less than 10° in shoulder)	decreased	normal	pronounced pain during movement or very markedpain at the end of the movement	somepain	no pain
Shoulder Flexion (0° - 180°) Abduction (0°-90°)External rotation Internal rotation	 0 0 0 0	 1 1 1 1	 2 2 2 2	 0 0 0 0	 1 1 1 1	 2 2 2 2
Elbow Flexion Extension	 0 0	 1 1	 2 2	 0 0	 1 1	 2 2
Forearm Pronation Supination	 0 0	 1 1	 2 2	 0 0	 1 1	 2 2
Wrist Flexion Extension	 0 0	 1 1	 2 2	 0 0	 1 1	 2 2
Fingers Flexion Extension	 0 0	 1 1	 2 2	 0 0	 1 1	 2 2
Total (max 24)				Total (max 24)		

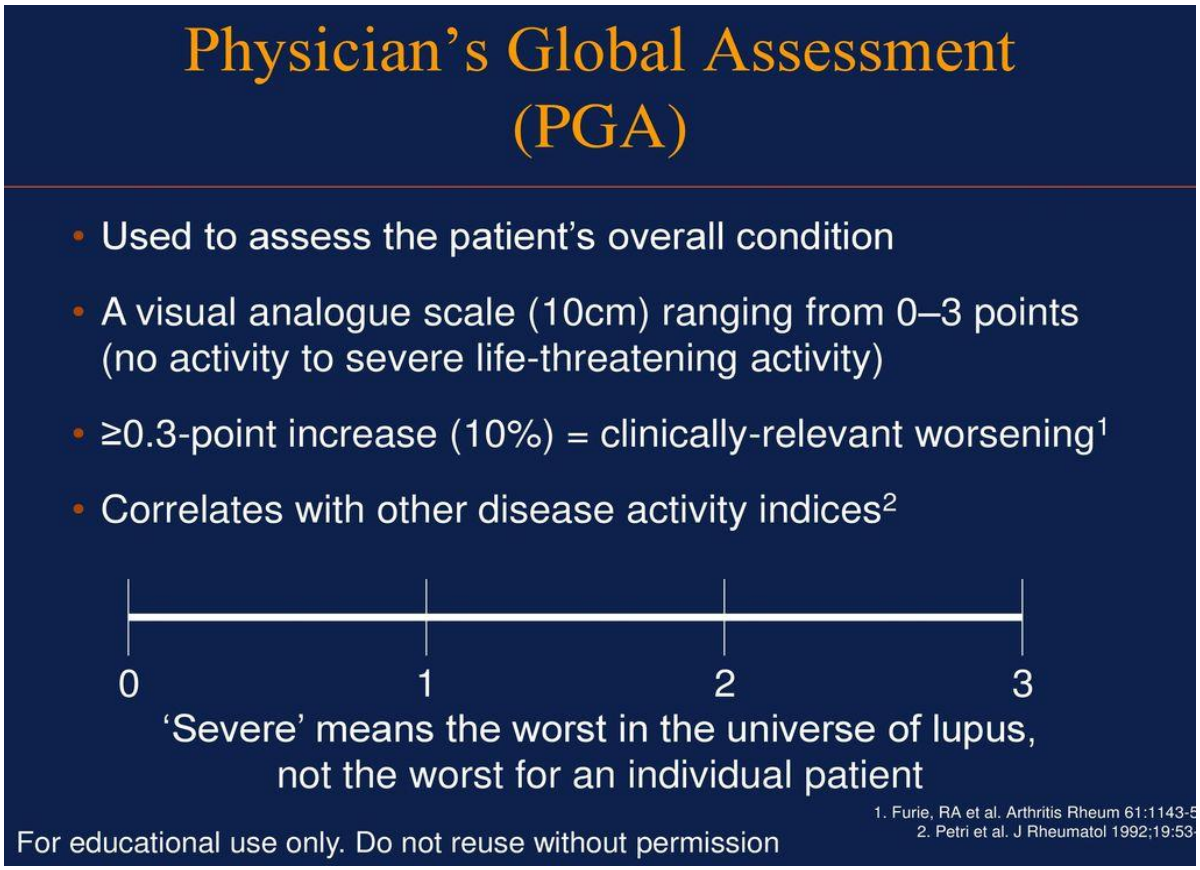
A. UPPER EXTREMITY	/36
B. WRIST	/10

C. HAND	/14
D. COORDINATION / SPEED	/ 6
TOTAL A-D (motor function)	/66

H. SENSATION	/12
J. PASSIVE JOINT MOTION	/24
J. JOINT PAIN	/24

Appendix 5

A sample Physician Global Assessment (PGA)



Appendix 6

Samples of Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire

Gundersen Lutheran
SPORTS MEDICINE

Patient Sticker

Disabilities of the Arm, Shoulder and Hand (*Quick* DASH)

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

		No Difficulty	Mild Difficulty	Moderate Difficulty	Severe Difficulty	Unable
1	Open a jar	1	2	3	4	5
2	Do heavy household chores (e.g. wash walls, wash floors)	1	2	3	4	5
3	Carry a shopping bag or briefcase	1	2	3	4	5
4	Wash your back	1	2	3	4	5
5	Use a knife to cut food	1	2	3	4	5
6	Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g. golf, hammering, tennis, etc)	1	2	3	4	5