NON-DRUG PAIN MANAGEMENT: OPPORTUNITIES TO EXPLORE

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Non-Drug Pain Management: Opportunities to Explore

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Abbrevations

NeP: Neuropathic Pain; HRQoL: Health-Related Quality Of Life; HRU: Health Care Resource Use; HCP: Health Care Provider; ER: Emergency Room; NPMs: Non-pharmacological Pain treatment Modalities; PTSD: Post-Traumatic Stress Disorder; PMR: Progressive muscle relaxation; LBP: Low Back Pain; FAM: Fear Avoidance Model; CBT: Cognitive-Behavioral Therapy; ABC: Antecedent-Belief-Consequence; AAA: Abdominal Aortic Aneurysm; CPSP: Chronic Postsurgical Pain; PSP: Postsurgical Pain; CAT: Complementary And Alternative Therapies; maxHR: maximum Heart Rate; NSCLBP: Non-Specific Chronic Low Back Pain; OA: Osteoarthritis; RCTs: Randomized Clinical Trials; DOMS: Delayed-Onset Muscle Soreness; CIM: Complementary And Integrative Medicine; VMT: Vocal Music Therapy; FA: Focused Attention, OM: Open Monitoring; FM: Fibromyalgia; RA: Rheumatoid Arthritis; EW: Expressive Writing; BC: Breast Cancer; IBS: Irritable Bowel Syndrome; PASTOR: Pain Assessment Screening Tool and Outcomes Registry; PROMIS: Patient-Reported Outcomes Measurement Information System; IMPACT: Completed Integrative Modalities Pain Care Team; FRP: Functional Restoration Program; DVPRS: Validation Of The Defense And Veterans Pain Rating Scale; PTSD: Post-Traumatic Stress Disorder; DoD: Department of Defense; PI: Pain Interference; PMTF: Pain Management Task Force; ED: Emergency Department; AAI: Animal Assisted Interventions; AAA: Animal Assisted Activities, AAT: Animal Assisted Therapy, SAP: Service Animal Programs; CTR: Chest Tube Removal; SI: Somatosensory Cortex; ACC: Anterior Cingulated Cortex; SI: Primary Somatosensory Cortex; SII: Secondary Somatosensory Cortex; PE: Pain Education; CH: Clinical Hypnosis; ART: Assisted Reproductive Technology; EWI: Expressive Writing Intervention; TENS: Transcutaneous Electrical Stimulation; TEAS: Transcutaneous Electrical Acupoint Stimulation; PENS: Percutaneous Electrical Nerve Stimulation; rTMS: Repetitive Transcranial Magnetic Stimulation; HVPC: High-Voltage Pulsed Current; IFC: Interferential Current; NMES: Neuromuscular Electrical Stimulation; PES: Pulsed Electrical Stimulation; NIN: Noninvasive Interactive Neurostimulation; PNS: Implanted Peripheral Nerve Stimulator; ROM: Range Of Motion; HSP: Hemiplegic Shoulder Pain; CRPS: Complex Regional Pain Syndrome; WINeRS: Wireless Implantable Neural Recording and Stimulation; TMT: Trunk Muscle Training; PPLBP: Postpartum LBP; EAP: Endometriosis-Associated Pain; UR: Urinary Retention; TBI: Traumatic Brain Injury; NPP: Neuropathic Pain; SCI: Spinal Cord Injury; PFP: Patellofemoral Pain; SCI: Spinal Cord Injury; AS: Ankylosing Spondylitis; RMDQ: Rolland Morris Disability Questionnaire; WOMAC: Western Ontario Macmaster; IASP: International Association for the Study of Pain; EEG: Electroencephalographic; SMT: Spinal Manipulative Therapy; CTP: Chronic Thoracic Pain; VAD: Vertebral Artery Dissection; CMP: Chronic Musculoskeletal Pain; CTTH: Chronic Tension-Type Headache; FHT: Family Health Team; PAWS: Pain Associated With The Spine; STRICTA: Standards for Reporting Interventions in Controlled Trials of Acupuncture; CMPS: Chronic Uncomplicated Musculoskeletal Pain Associated With The Spine; AAOS: American Academy of Orthopedic Surgeons; NICE: National Institute for Health and Care Excellence; TKA: Total knee arthroplasty; UROPP: Ultra-restrictive Opioid Prescription Protocol for Pain; PLHIV: People Living with HIV; PT: Physical Therapy; MM: Multiple Myeloma; hESC: Human Embryonic Stem Cell; SDM: Shared Decision-Making; OT: Occupational Therapy; APTA: American Physical Therapy Association; FAIR: Flexion, Adduction, And Internal Rotation; FAI: Femoroacetabular Impingement; TEMPA: Test d'Évaluation des Membres Supérieurs de Personnes Âgées; MS: Multiple Sclerosis; BDNF: Brain Derived Neurotrophic Factor; YoA: Yoga of Awareness; IAYT: Integrated Approach Of Yoga Therapy; TUG: Timed Up and Go Test; STS: Sit-to-Stand; HGS: Handgrip Strength; MPDS: Myofascial Pain Dysfunction Syndrome.

Abstract

Figure 1: Graphical Abstract. Over 76 million individuals in the United States (that is one in every four Americans) have experienced pain that lasts longer than 24 hours. Millions more suffer from acute pain every day. According to recent statistics put forth by the National Institutes of Health, "pain affects more Americans than diabetes, heart disease, and cancer combined." (Source: Dr. Veronique Desaulniers. In Pain? 7 Natural Pain Management Techniques to Consider. Web the Truth About Cancer October 5, 2016).

Aristotle (4th century B.C.) described pain as emotion, being the opposite of pleasure. Whereas, Buddha stated "Pain is the outcome of sin", as evidence that an individual was possessed by demons. In some religions it is the cost of attachment. Spiritual counseling thus may be more of a priority than medical management. Many non -physiologic factors (psychological, familial and societal attitudes, life stressors, and cultural or spiritual) contributing to the experience of and response to pain. Emotional stress such as anxiety and depression play a key role in experience of pain. Chronic pain is associated with increased levels of depressive symptoms, anxiety, and insomnia regardless of disability status. it has both modifiable factors (mental health, co-morbidities, smoking, alcohol, obesity, physical activity/exercise, sleep, nutrition, economic status and occupational) and non-modifiable factors (age, sex, cultural and socioeconomic background, history of trauma/ injury/ interpersonal violence, heritage). The relationship between increased BMI and chronic pain in adults seems intuitive and may be related, in part, to increased weight-bearing on joints, reduced physical activity and deconditioning. Patient with physical disabilities may have co-occurring chronic pain, but the prevalence and specific associated factors are unknown. Neuropathic pain (NeP) can be the result of a variety of conditions, including metabolic disease, infection, malignancy, trauma, medications, and toxins; estimates of 60% among those with chronic pain. Chronic pain affects 20% of the European population and is commoner in women, older people, and with relative deprivation. Its management in the community remains generally unsatisfactory, partly because of lack of evidence for effective interventions. Also, family and caregivers' beliefs and attitudes towards pain, either positively and negatively to tolerate and express pain are important. Risk factors include socio-demographic, clinical, psychological, and biological factors. Pain increases depression risk 3-5-fold. Pain, rather than chronic disease, is associated with the recurrence of depressive and anxiety disorders; 50–80% of chronic pain patients report insomnia of a severity that warrants clinical attention. It is estimated that approximately one in five of the adult population in Europe suffers chronic pain, which is therefore more prevalent than asthma or diabetes. Chronic pain has long-term biological, psychological and social causes and consequences that are important in prevention and management.

Keywords: Pain; Patient; Back Pain; Cancer; Fibromyalgia; Osteoarthritis; Surgical Pain

Highlights

1. The costs associated with chronic pain incurs an annual cost of $874 billion by the US population.
2. Approximately 70 to 85% of the western population will develop low back pain at least once during their lifetime.
3. In France, work productivity loss contributed almost 90% of the total costs incurred by patients with fibromyalgia
4. Pain killers are usually associated with a variety of adverse side effects, such as constipation, urinary retention, nausea, sedation, respiratory depression, myoclonus, delirium, sexual dysfunction, and hyperalgesia.
5. The economic burden of prescription opioid overdose, abuse and dependency is estimated to be $78.5 billion each year in the United States.
6. Chronic pain affects 20% of the European population and is commoner in women, older people, and with relative deprivation.
7. Neuropathic pain (NeP) estimates of 60% among those with chronic pain.
8. Asia, Africa, and Latin America are collectively home to more than 50% of cancer patients; with more than half of global cancer-related mortalities occurring in Asia alone.
9. Cancer pain is prevalent in almost 50% of all cancer patients and more than 70% of patients with advanced cancer.
10. Postoperative pain is not adequately managed in greater than 80% of patients in the US.
11. The economic burden of migraine in the United States was $36 billion in 2016.
12. Mild -to-moderate pain may be relieved by non-drug techniques alone. Moderate- to-severe pain may require medication in addition to nondrug techniques
13. Non-drug techniques can decrease pain intensity and can decrease awareness of pain to enable better coping some have been proven to work
14. Public and private insurers have not yet widely adopted payor policies that are consistent with the ACP guideline, National Pain Strategy, and reported patient preference
15. It has been estimated that 12.5% of men and 5.2% of women who aged 74–84 years had Abdominal Aortic Aneurysm (AAA). Furthermore, evidence has revealed that approximately 11,000 deaths were attributed to AAA each year in the United States.
16. Chronic Postsurgical Pain (CPSP) reported 50%–85% following limb amputation, 11%–57% following mastectomy, 30%–55% after cardiac surgery, 5%–65% after thoracotomy, and 5%–63% following hernia repair.
17. Companion of choice at birth increases the likelihood of vaginal births, reduces the need for caesarean sections, the use of forceps or vacuum during vaginal births, need to use pain medications during labor, shortens the duration of labor, improves women's satisfaction with care and improves Apgar scores.
18. An 8-week moderate intensity aerobic exercise at 40%–60% of heart rate reserve combined with conventional physiotherapy, significantly reduced nearly 50% Non-Specific Chronic Low Back Pain (NSCLBP).
19. Of those who suffer from Hemiplegic Shoulder Pain (HSP), up to 75% report moderate to severe pain with a third refractory to available treatments.
20. TENS as an adjunct is effective in reducing lower limb spasticity when applied for more than 30 minutes over nerve or muscle belly in chronic stroke survivors.
21. Although acupuncture is widely used to manage chronic pain, it remains highly controversial, largely due to the lack of a clear mechanism.
22. Physical therapy should strongly be considered for the management of chronic pain to gradually increase flexibility and strength.
23. Despite a number of reports and reviews supporting efficacy of yoga in health care, the awareness and integration of yoga in conventional healthcare remain limited.
24. An 8-week yoga intervention resulted in improvement in pain and quality of life scores compared to the control group that was treated with NSAIDs.

25. Modern medical system suggests Complementary and Alternative Medicine (CAM) and pharmacotherapy together, instead of long-term use of pain killers alone (Figure 2).

Figure 2: Pain Cycle. When a person gets injured, the common response to pain is to guard their muscles. Over time, however, that guarding pattern, combined with fear, interferes with mobility—and when the patient reduces mobility, that in turn can cause more pain leading to increased lak of mobility, often including anger, frustration, and a sense of helplessness—truly a vicious cycle. Early intervention is really the key to prevent the onset of the cycle of chronic pain. If an injury is sustained—perhaps from a fall—and it still hurts a week after the event, certainly it should be assessed. It may, as the result of this assessment, recommended a course of treatment, or refer the patient to a massage therapist, a physical therapist, or an orthopedic surgeon or neurosurgeon, depending on the type and severity of the injury (Source: Duncan CA. The Goal: Break the Chronic Pain Cycle. Web Health & Healing Online).

Introduction

Pain is an important determinant of HRQoL. Unfortunately, the experience of pain is frequently characterized by undue physical, psychological, social, and financial suffering. Adults who reported experiencing a pain condition in the prior month were found to have greater work productivity loss and HRU, including HCP and ER visits, and hospitalizations, than controls. Indirect costs due to work impairment, early retirement, and disability appear to account for much of the financial burden and hospitalizations being the greatest factor affecting direct costs. Poorly controlled acute postoperative pain is associated with increased morbidity, functional and quality-of-life impairment, delayed recovery time, prolonged duration of opioid use, and higher health-care costs. Conventional opioids remain the standard of care for the management of acute postoperative pain; however, the risk of opioid-related adverse events can limit optimal dosing for analgesia, leading to poorly controlled acute postoperative pain. Toxicity of traditional pain modulation with pain killers are well reported and toxic effects and potential dependence of synthetic opioids are not completely understood yet. Deaths from overdoses of opioids and opiates had very large increases in the United States between 2000 and 2014, a pattern not seen before in history. Famous celebrities like Bruce Lee, Chris Penn, Elvis Presley, Heath Ledger, Anna Nicole Smith died from opioid overdose. The economic burden of prescription opioid overdose, abuse and dependency is estimated to be $78.5 billion each year in the United States. Maintaining focus on biomedical treatments, including drugs, has limited success in chronic pain. Moreover, a large US outpatient study found that only 0.12% of chronic pain consultations involved pain specialists. Active self-management and healthy lifestyle choices are fundamental to addressing multisystem complexity and harnessing neuroplasticity in chronic pain. Analgesic pharmaceutical drugs are usually associated with a variety of adverse side effects, such as constipation, urinary retention, nausea, sedation, respiratory depression, myoclonus, delirium, sexual dysfunction, and hyperalgesia. Using UROPP to manage postsurgical pain after discharge did not result in any negative health consequences. These instances clearly reveal importance of understanding current evidence on noninvasive nonpharmacological treatment of chronic pain. Consensus guidelines recommend multi-modal chronic pain treatment with increased uptake of NPMs. The challenge of achieving adequate pain control without adverse side effects further compounds the problem and provides rationale for seeking complementary medicine alternatives.

Prevalence and Economic Burden of Chronic Pain

Over 100 million Americans are living with chronic pain, and pain is the most common reason that patients seek medical attention [1]. In France, work productivity loss contributed almost 90% of the total costs incurred by patients with fibromyalgia [2]. Chronic uncomplicated neck pain, back pain, and lower back pain, with incidences of 18%, 17.7% and 36%, respectively [3]. In a Canadian study of patients waiting for multidisciplinary pain treatment, direct and indirect costs were CAN$1,462 with time costs accounting for 84% of overall total costs [4]. The US spent 17.8% of it ' s GDP on healthcare in 2015, expected to increase to 20% or higher by 2025 [5,6]. The direct and indirect costs associated with chronic pain from any cause in the USA are estimated to range from US$560 to US$635 billion yearly, which is almost twice as much as for cardiovascular diseases or cancer [4]. However, it affects nearly 1 of 2 adults and incurs an annual cost of $874 billion, found in another study [7]. These cost estimates are proportionally similar to those of European countries such as Ireland (€5.34 billion per year) and Sweden (€32 billion per year). Approximately 70 to 85% of the western population will develop low back pain at least once during their lifetime. Of the people that consult their general practitioner for low back pain, one year later about 60% still report pain [8]. More than 50% pregnant women suffer from LBP during their pregnancy and such incidence has been reported as 78%. Such painful condition can result in a long-term pain and disability after the delivery [9-11]. Pain is a common complication after SCI with prevalence of 18 to 96%, and almost 30% of this pain are diagnosed as neuropathic pain. The intensity of the pain varies amongst these patients and it has been reported that 77.7% of patients with spinal cord injuries have moderate to severe pain [12]. Asia, Africa, and Latin America are collectively home to more than 50% of cancer patients; with more than half of global cancer-related mortalities occurring in Asia alone [13]. Studies have shown that at least 20–40% of cancer pain were not adequately relieved by application of the analgesic ladder [14]. Endometriosis-associated pain (EAP) has been reported that about 6% to 10% women (Manifested as dysmenorrhea, non-menstrual pelvic pain, and dyspareunia) [15]. Cancer pain is prevalent in almost 50% of all cancer patients and more than 70% of patients with advanced cancer. About half of patients suffer with advanced cancer experience moderate-to-severe pain, while almost a quarter of patients suffer with more severe pain [13]. Pain is also associated with cancer treatment with more than 25% of patients enduring moderate-to-severe pain during treatment [16]. Postoperative pain is not adequately managed in greater than 80% of patients in the US, although rates vary depending on such factors as type of surgery performed, analgesic/anesthetic intervention used, and time elapsed after surgery [17]. Chronic orchialgia is defined as testicular pain, which may be either unilateral or bilateral, lasting for more than 3 months It is estimated that 25% of chronic orchialgia cases are idiopathic [18]. Migraine is now ranked as the second most disabling disorder worldwide reported by the Global Burden of Disease Study 2016 [19]. The prevalence and burden of self-reported migraine and severe headache in the US adult population is high, affecting roughly 1 out of every 6 American and 1 in 5 women over a 3-month period. Headache is consistently the fourth or fifth most common reason for visits to the emergency department, accounting for roughly 3% of all ED visits annually. In reproductive aged women, headache is the third leading cause of emergency department visits [20]. The economic burden of migraine in the United States is substantial. In 2016, these direct and indirect costs amounted to an estimated total annual cost of $36 billion [21]. The incidence rate of MM is three times higher in more developed countries compared to lesser-developed countries. The bone tissue destruction in MM results in bone pain, pathological fractures, and less frequently spinal cord compression [22] (Table 1, Figure 3).

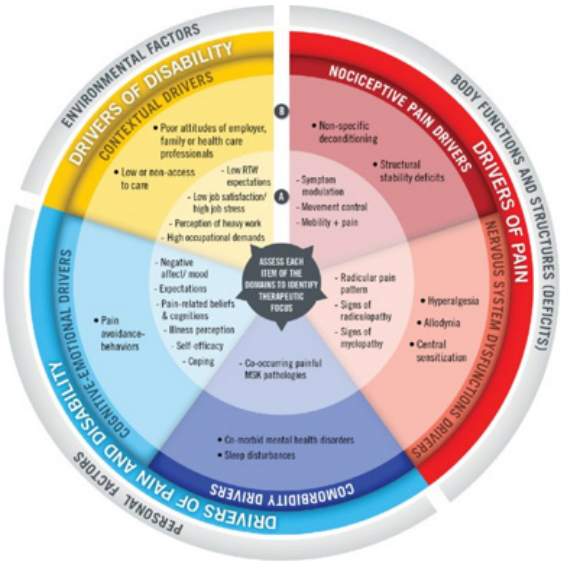

Figure 3: Pain and disability driver management model. (A) refers to more common and/or modifiable elements; (B) refers to elements that are more complex and less modifiable, and that will prompt more aggressive or require interdisciplinary care to effectively address the problematic domain. Abbreviations: RTW, return to work; MSK, musculoskeletal. Patients present with certain physical and/or mental health comorbidities that can influence other domains driving symptom severity and disability. Musculoskeletal conditions such as low back pain, joint pain, arthritis, and rheumatism are the leading causes of disability in people during their working years. In addition to its significance as a personal and clinical problem, chronic pain has become a sociopolitical and economic problem for public and private disability insurers. Although the costs to disabled persons of their diminished well-being cannot be accurately measured, disability program expenditures can be estimated. There are many programs and policies to serve disabled workers. They differ in terms of their eligibility criteria, the extent to which the receipt of benefits is subject to a means test, the limits on the level of market earnings allowed for continuation of benefits, and the degree to which these benefits are taxable (Source: Institute of Medicine (US) Committee on Pain, Disability, and Chronic Illness Behavior; Osterweis M, Kleinman A, Mechanic D, editors. Pain and Disability: Clinical, Behavioral, and Public Policy Perspectives. Washington (DC): National Academies Press (US); 1987. 5, Economic Issues and the Cost of Disability. Available from: https://www.ncbi.nlm.nih.gov/books/NBK219239/?report=classic).

Table 1: Pathophysiologic Consequences of Unrelieved Pain [308-313].

Immune system	Decreased natural killer cell number, function and activity. Can lead to death.
Pulmonary system	Reflex muscle spasm leads to splinting which decreases pulmonary vital capacity, functional residual capacity, alveolar ventilation. Leads to atelectasis, which often is followed by pneumonia and hypoxemia.
GI system	Increased sympathetic activity, which increases GI secretions and smooth muscle sphincter tone decreases intestinal motility. Leads to gastric stasis and paralytic ileus.
CVS	Sympathetic over activity which increases heart rate (decreased O2 to heart), peripheral resistance, BP, cardiac output, and O2 use. Leads to hypoxemia and ischemia, especially of the heart and peripheral tissues.
Musculoskeletal system	Segmental and supra segmental reflexes with increased muscle spasm leads to impaired muscle metabolism and to muscle atrophy.
Psychologic consequences	Anxiety, fear, depression, distress, and suffering, hopelessness, helplessness and a decreased will to live (wish for assisted suicide or euthanasia).
Neuronal plasticity	Primary and secondary hyperalgesia with enabled NMDA receptors and aberrant communication of neurons in the peripheral and central nervous system.

Potential merits and misunderstandings of non-drug techniques

Mild -to-moderate pain may be relieved by non-drug techniques alone. Moderate- to-severe pain may require medication in addition to nondrug techniques [23,24]. Advantages to nondrug interventions are:

a) Low cost and low risk of side effects,

b) Decrease in a patient's unhelpful emotional reactions (such as anxiety, depression, aggressive behavior)

c) Increase in a patient's sense of personal control and hope,

d) Better sleep and improved interpersonal relationships.

e) Increase the individual control feeling and decrease the feeling of weakness.

f) Improves the activity level and functional capacity.

g) Reduces the pain behavior and focused pain level.

h) Reduces the needed dosage of analgesic drug s thus decreasing the side effects of the treatment [23,25,26] (Figure 4).

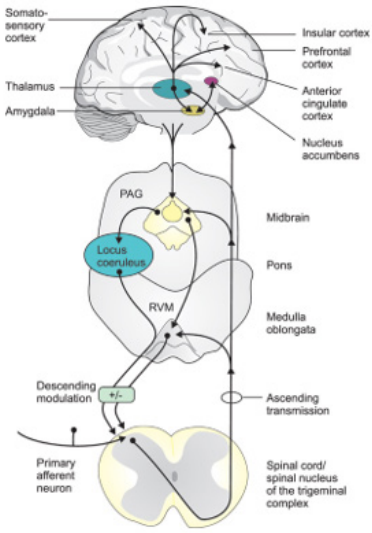

Figure 4: Pathways and brain regions involved in the transmission and modulation of pain signals. Primary afferent neurons, with their cell bodies in the dorsal root ganglia, or trigeminal ganglion (mouth and face), couple over to secondary neurons in the dorsal horn of the spinal cord, or the spinal nucleus of the trigeminal complex. The axons of the second order neurons cross the midline and project to the thalamus and a variety of other targets in the medulla oblongata, pons and mid brain, including the rostral ventral medulla (RVM) and the periaqueductal grey (PAG). Third order neurons, with their cell bodies in the thalamus, project to the somatosensory cortex, responsible for the sensory-discriminative aspects (intensity, location and quality) of pain, and to limbic cortical areas, such as the anterior cingulate, insular, and the prefrontal cortex involved in the mediation of the affective/emotional components (aversiveness) of pain. Thalamic neurons also project to the amygdala, which in turn interacts with the nucleus accumbens, a region involved in both pain processing and the mediation of reward- motivational behavior. These various brain regions also give input to the PAG, which via the raphe nuclei in the RVM, and to the locus coeruleus, send descending pain modulatory projections back to the first synapses in the afferent pathways (Source: Brodin E, Ernberg M, Olgart L. Neurobiology: General considerations - from acute to chronic pain. Nor Tannlegeforening Tid. 2016; 126: 28-33)

While, potential demerits include not as well researched (a technique that works well for one person may not work well for another) [27]. Misunderstandings may keep patients and staff from trying the techniques but truth is: some patients may find the techniques burdensome or stressful, advanced techniques require special training (music and art therapy, therapeutic massage) [28]; non-drug techniques can decrease pain intensity and can decrease awareness of pain to enable better coping some have been proven to work; others are less well studied [26]. moderate- to-severe pain typically requires a combination of medication and nondrug therapy; hot and cold can work when applied to the opposite side of the body, or at a different site [29], enabling these techniques to be used when radiation therapy or open wounds prohibit use at the site of pain distraction can decrease pain and increase ability to cope; successful distraction does not mean pain is not real [30] (Figure 5).

Figure 5: The fear-avoidance model. Psychological factors play a significant role in both acute and chronic back pain, and in the transition from acute to chronic pain. Psychosocial factors have in fact been found to have a greater impact than biomedical or biomechanical factors on back pain disability. Patients with a fear of the long-term consequences of surgery are also at increased risk of long-term pain and poor recovery. Educating patients and their carers about pain encourages a more positive attitude to pain relief5 and where possible we should try to involve patients in their pain management strategy. Information can provide reassurance that the sensations experienced after a procedure are normal and non-threatening. For example, following a total knee replacement, patients are encouraged to mobilize within hours of surgery. This may be uncomfortable, but it is important that patients are reassured that pain does not equal damage, that it is normal to experience some discomfort and it does not mean that they are jeopardizing their operation or that something is wrong. Through active involvement patients develop a greater sense of self-efficacy regarding treatment and disease-related behaviors and may be more likely to follow through on management decisions reached. Patients who respond passively to pain show greater distress and disability compared with those who attempt to solve the problem. Taking some control over the cause of pain or the method of analgesia has a beneficial effect. Social relationships can also influence pain reporting and disability. The expressions of pain are reinforced by the partner who acts to alleviate the patient's behavioral activity, and this is reflected in the increased level of pain (Source: Reddi D, Curran N Chronic pain after surgery: pathophysiology, risk factors and prevention Postgraduate Medical Journal 2014;90: 222-227).

Non-Drug Options of Pain management

Unfortunately, non-pharmacological therapy is seldom used for acute postoperative pain relief, although it is beneficial and devoid of any significant adverse effects. Nonpharmacologic therapies have demonstrated benefit for acute pain with opioid sparing in hospital settings for inpatient post-operative pain and for acute pain not related to surgery [31,32]. Non-pharmacological pain management is the management of pain without medications [33]. Non-pharmacological methods used in pain management can be classified in different ways. In general; they are stated as physical, cognitive, behavioral and other complementary methods or as invasive or -non-invasive methods. This method utilizes ways to alter thoughts and focus concentration to better manage and reduce pain. Methods of non-pharmacological pain include:

A. Education and psychological conditioning

B. Hypnosis

C. Comfort therapy

D. Physical and occupational therapy

E. Psychosocial therapy/counseling

F. Neurostimulation

G. Biofeedback techniques

H. Electrical stimulation

Table 2: Selected Pain Terminology [303,53].

Pain	An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage.
Pain from pathogenic/biological origin	osteoarthritis (OA), rheumatoid arthritis (RA), systemic inflammatory rheumatic diseases, connective tissue diseases, post-herpetic neuralgia, and peripheral neuropathy, which are typically diagnosed via objective biologic or inflammatory markers, radiologic evidence or other identifiable tissue damage.
Pain from idiopathic origin	which often rely on subjective patient report, include complex regional pain syndrome (CRPS), fibromyalgia (FM), chronic widespread pain (CWP), subsets of chronic low back pain (LBP), and chronic pelvic pain (CPP).
Nociceptive pain	pain that arises from actual or threatened damage to nonneural tissue and is due to the activation of nociceptors (high threshold sensory receptors of the peripheral somatosensory nervous system that can transduce and encode noxious stimuli). This term, designed to contrast with neuropathic pain, is used to describe pain occurring with a normally functioning somatosensory nervous system as opposed to the abnormal function seen in neuropathic pain.
Inflammatory pain	pain in the presence of inflammation that is increased by pressure.
Dysfunctional pain	maladaptive pain, typically triggered without an external stimulus, which does not serve a known protective function (e.g., pain associated with fibromyalgia, irritable bowel syndrome, and some types of headache).
Neuropathic pain	pain caused by a lesion or disease of the somatosensory nervous system. Neuropathic pain is a clinical description (and not a diagnosis) that requires a demonstrable lesion or a disease that satisfies established neurological diagnostic criteria.

I. Meditation [23,25,31-39] (Table 2)

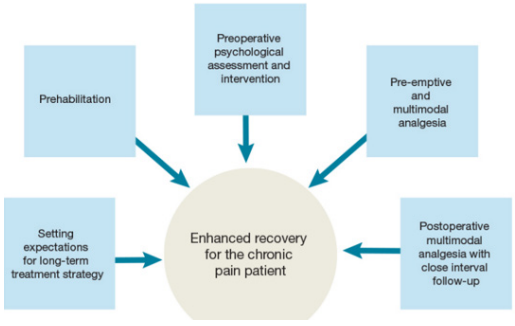

Figure 6: Enhanced recovery for the chronic pain patients. Strategies implemented preoperatively optimize the patient for surgery. Intraoperative and postoperative interventions continue a multimodal approach to pain management. Preoperative counseling for elective procedures generally occurs in the outpatient setting. Although discussion traditionally has covered the type of procedure and its associated risks, benefits, and alternatives, new guidelines suggest a more mindful and comprehensive approach is warranted. Individualized patient-centered education programs have a positive impact on the perioperative course, effecting reductions in preoperative anxiety, opioid requirements, and hospital length of stay. Prehabilitation is the process of increasing functional capacity before surgery in order to mitigate the stress of the surgery. Prehabilitation may involve aerobic exercise, strength training, or functional task training [Source: Moulder JK, Johnson KP. Enhanced recovery after surgery for the patient with chronic pain. OBG Manag. 2018 March;30(3)].

Clearly, public and private insurers have not yet widely adopted payor policies that are consistent with the ACP guideline, National Pain Strategy, and reported patient preference. Specifically, most health plans surveyed did not have policies in place that [31] emphasize the use of nonpharmacological treatments at the forefront of the patient experience; [32] provide meaningful levels of coverage for care professionals who focus on guideline-adherent nondrug therapies such as spinal manipulation, exercise, massage, acupuncture, and cognitive behavioral therapy; or [33] use financial incentives that favor the use of nonpharmacologic options over commonly prescribed pharmaceuticals, including opioids [40] (Figure 6,Table 3).

Table 3: Cognitive–emotional drivers [321].

Categories	Operational definition and elements
Maladaptive cognition	Cognitive–emotional drivers include maladaptive cognitive strategies toward pain (i.e., pain coping, pain catastrophizing), pain-related fears (ie, pain-related anxiety and fear, fear of movement), negative perception of pain/disability and expectations toward pain (i.e., illness perception, pain self-efficacy), as well as negative mood (which is distinct from clinical depression). According to the fear-avoidance model, when maladaptive cognitive drivers are not addressed and if pain/disability persists, factors such catastrophizing, illness perceptions, negative emotions, and pain-related fears may lead to the development of maladaptive behaviors (e.g., activity avoidance), which, in turn, may contribute to the maintenance of pain-related disability.
Maladaptive behaviors	Maladaptive behaviors can be manifested in various ways. For example, they may include "communicative" pain behaviors such as facial expressions (e.g., grimacing or wincing) or verbal/paraverbal pain expressions (e.g., pain words, grunts, sighs, and moans). They may also include "protective" or "safety" behaviors such as guarding of the back straight while lifting or bending/rubbing the back after performing an activity, strongly bracing before doing a functional task, or even completely avoiding performing a task. In addition to avoidance, displays of "protective/safety" behaviors (e.g., guarding, holding, or rubbing the back) or communicative pain behaviors (e.g., grimaces) have also been associated with heightened levels of perceived functional disability. Maladaptive behaviors are known to be strongly influenced by cognitive–emotional factors; their presence suggests that cognitive–emotional drivers of pain must be assessed and addressed through behavioral or cognitive-behavioral treatment interventions.
They are clearly linked to enhanced pain perception, are predictors of long-term disability, and can explain the presence of persistent painful symptoms. As personal factors of an individual, the fourth domain relates to cognitive–emotional drivers, as "maladaptive cognition" (category A) and "maladaptive behaviors" (category B) will undeniably influence the treatment approach.	

Education and psychological conditioning

High levels of pain, significant anxiety, or depressive symptoms before surgery put patients at elevated risk for chronic pain and prolonged opioid use following surgery [41]. Preoperative depression has been linked to a variety of adverse outcomes following lumbar fusion, including increased pain, disability, and 30-day readmission rates. The association between depression and opioid use following lumbar fusion is increasingly relevant given the epidemic of opioid abuse sweeping the country in recent years [42]. It has been estimated that 12.5% of men and 5.2% of women who aged 74–84 years had AAA. Furthermore, evidence has revealed that approximately 11,000 deaths were attributed to AAA each year in the United States. Over one-fourth of patients scheduled for AAA repair may have preoperative anxiety or depression [43]. Current psychological approaches to the management of chronic pain include interventions that aim to achieve increased self-management, behavioral change, and cognitive change rather than directly eliminate the locus of pain. As such, they target the frequently overlooked behavioral, emotional, and cognitive components of chronic pain and factors contributing to its maintenance [44] (Figure 7,Table 4).

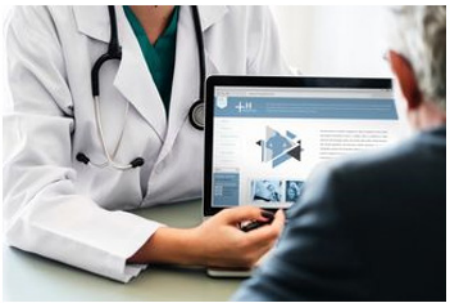

Figure 7: Pre- and Post-Operative Education and Psychological Conditioning. Individualized education is important for preparing patients for the operation both physically and psychologically. surgeries cause emotional, cognitive and physiological reactions in patients. Patients undergoing surgical intervention usually experience worries over outcomes such as becoming permanently disabled, loss of control over their body, loss of working ability, pain, loss of sexual ability, inability to wake up from anesthesia, and fear of death. Due to fear and anxiety, majority of patients have difficulty in coping with the operation process. Not having information about the diagnosis and treatment methods, patients may experience anxiety, including depression, in the pre-operation period. Studies report that with individualized care and education, patients' anxiety decreases, and their satisfaction increases. The individualized education is given to patients before surgery was found to have potential effects on their post-operative pain levels (Source: Ertürk EB, Ünlü H. Effects of pre-operative individualized education on anxiety and pain severity in patients following open-heart surgery. Int J Health Sci (Qassim). 2018;12(4):26-34.)

Table 4: Psychological interventions in the management of patients with chronic pain.

Approaches	Description

Psychophysiological techniques	Biofeedback is a learning technique through which patients learn to interpret feedback (in the form of physiological data) regarding certain physiological functions. For example, a biofeedback device may show measurements of muscle tension. Biofeedback may help to control pain, including chronic headaches and back pain [44,149].
Behavioral approaches (Relaxation Training) It can help reduce muscle tension and stress, lower blood pressure, and control pain [149].	Diaphragmatic breathing is a basic relaxation technique lowering the harmful effects of the stress hormone cortisol, HR, BP and chances of injuring or wearing out muscles. It helps to cope with the symptoms of PTSD. It improves core muscle stability, body's ability to tolerate intense exercise [289]. PMR is a systematic technique used to achieve a deep state of relaxation and has been shown to improve health-related QOL in a variety of medical and psychiatric illnesses. It is an effective and widely used strategy for stress relief that creates a state of deep relaxation by involving alternate tensing and relaxing of muscles [290,291]. Autogenic training (AT) combines passive concentration, visualization and deep breathing techniques, likely to produce Diaphragmatic breathing is a basic relaxation technique lowering the harmful effects of the stress hormone cortisol, HR, BP and chances of injuring or wearing out muscles. It helps to cope with the symptoms of PTSD. It improves core muscle stability, body's ability to tolerate intense exercise [289]. PMR is a systematic technique used to achieve a deep state of relaxation and has been shown to improve health-related QOL in a variety of medical and psychiatric illnesses. It is an effective and widely used strategy for stress relief that creates a state of deep relaxation by involving alternate tensing and relaxing of muscles [290,291]. Autogenic training (AT) combines passive concentration, visualization and deep breathing techniques, likely to produce specific cognitive effects such as reducing anxiety and enhancing positive mood. The emphasis is to not to control these natural healing systems, but rather to use their intrinsic potentials more fully. Autogenic training is the preferred mode of arousal regulation in many European countries [292,293,159]. Visualization/Guided imagery is one component of CBT that frequently is used and found effective in fibromyalgia. Imagery has been defined as a dynamic, psycho-physiological process in which a person imagines, and experiences, an internal reality in the absence of external stimuli. The guided imagery audio is accompanied by soft background music and directs the visualization and imagination to a pleasant and peaceful place that has meaning for the participant to replace negative or stressful feelings [294,295]. FAM of chronic pain is a heuristic most frequently applied in the context of non-operative populations like chronic LBP. The FAM is a psychosocial model that seeks to understand the role of cognitive, behavioral, physical, and emotional factors in persistence of pain and disability. FAM measures have moderate relationships with preoperative pain and disability. Preoperative depression and work-related fear-avoidance beliefs were able to significantly explain the 10-week clinical outcome variances (leg pain, back pain, and disability) [296,297].
Cognitive-behavioral approaches	CBT interventions are delivered within a supportive and empathetic environment that strives to understand the patient's pain from a biopsychosocial perspective and in an integrated manner, most common psychologic intervention for individuals with chronic pain. CBT is generally based on the "ABC" model and aims at changing dysfunctional thoughts, emotions, and behaviors. Additionally, CBT has been reported to improve quality of life and activities of daily living, chronic headache, facial pain, arthralgia, and fibromyalgia. Behavior modification strategies to effectively reduce pain and fatigue, and improve sleep, overall physical function and coping CBT focuses on reducing pain and distress by modifying physical sensations, catastrophic thinking, and maladaptive behaviors. Combining CBT approaches for pain and for sleep may produce greater improvements in pain and sleep outcomes compared to either approach in isolation. Women benefit more from multimodal pain therapy including CBT-oriented group program than men. CBT had similar effects with fusion spine fusion surgery, but at 12 months the CBT group showed less fear avoidance [44,46,54,298-301].
Acceptance-based approaches	Acceptance and commitment therapy (ACT) are the most common of the acceptance-based psychotherapies. ACT is a relatively newer psychological intervention being implemented in the chronic pain health care setting. ACT is based on behavioral principles and the psychological flexibility model, and unlike CBT, it does not emphasize the restructuring of distorted or catastrophic cognitions. The goal within ACT is to reduce the dominance of pain in person's life through increased psychological flexibility. Unlike other approaches, ACT does not focus on symptom reduction – even though this can happen in ACT – but on making patients' responses toward symptoms more successful in relation to their own goals. When used as an adjunctive therapy in pain management, ACT fosters the possibility of improved pain acceptance, which can have important implications for adaptive recovery in postsurgical patients [44,46,302].

Table 5: Evolution of behavioral psychotherapeutic approaches [54].

	Behavioral psychotherapy type	Theoretical background
First wave	Behavioral therapy	Behavior analysis takes into consideration every behavior, including overt and covert The therapist focuses on specific learned behaviors and how the environment influences such behaviors
Second wave	Cognitive behavioral therapy	CBT focuses on the development of individual strategies aimed to solve current problems and to change unhelpful patterns in cognitions (i.e., thoughts and beliefs), behaviors, and emotional regulation
Third wave	Acceptance and commitment therapy Dialectical behavioral therapy Integrative behavioral couples' therapy Behavioral activation Cognitive behavioral analysis	Third wave therapies prioritize the holistic promotion of health and well-being and are less focused on reducing psychological and emotional symptoms. These therapies abandon key assumptions associated with traditional cognitive therapy and is informed by emerging research in cognitive psychology and neuroscience. Concepts such as metacognition, acceptance, mindfulness, personal values, and spirituality are frequently incorporated into what might otherwise be considered traditional behavioral interventions

Pain lasting longer than the normal healing process after surgery is an unwanted adverse event in any operation. CPSP can represent a severe nuisance to patients, leading to functional limitation and psychological trauma, as well as a problem for the operative team in the form of feelings of frustration and disappointment. Studies have reported incidences ranging from 50%–85% following limb amputation, 11%–57% following mastectomy, 30%–55% after cardiac surgery, 5%–65% after thoracotomy, and 5%–63% following hernia repair. One reason for this variability is the difference in the time reference considered by each researcher for labeling pain as CPSP (varying from 2 months to 1 year postoperatively). More than a half of CPSP patients have neuropathic pain, the remainder having nociceptive (somatic or visceral) pain. A patient may have different components of pain, and these must be identified for effective management. During the preoperative and early postoperative period, it is very important to provide patient education and counselling about the chances of developing CPSP [45]. Multidisciplinary pain-management programs with psychological approaches, including CBT and mindfulness-based psychotherapy, have shown efficacy as treatments for chronic pain, and show promise as timely interventions in the pre/perioperative periods for the management of PSP [46] (Table 5).

Comfort Therapy

Complementary therapies can increase comfort, decrease pain, promote relaxation and increase the quality of life for hospice patients and their families. Therapies can be used individually or in combination. All therapies are individually tailored for each patient to offer unique benefits [47]. Comfort therapy can help improve the quality of life by alleviating symptoms of pain and providing relaxation and comfort. Response to treatment or therapy is individual and that what works for some might not be as effective for others [48]. Studies suggest that CAT enhance quality of care for patients nearing the end of life. Some types of CAT are associated with a lessening of symptoms, including anxiety and pain, and improvements in mood and sense of control [49]. Comfort therapy may involve the following:

Companionship

Patients with chronic pain from a non-supportive family tended to show more pain behaviors and more emotional distress compared with pain patients coming from supportive families [50]. Due to inadequate knowledge and skill, family caregivers may be unfamiliar with the type of care they must provide or the amount of care needed [51]. According to the Operant Conditioning Model of Chronic Pain, both verbal and non-verbal forms of communication are used to convey patients' desire for support, attention and intimacy, and to elicit empathic responses from others. In turn, affected patients' communication may be maintained by social reinforcement (e.g. the sympathetic response of significant others) [52]. WHO recommend intervention to improve labor outcomes and satisfaction. Companion of choice at birth increases the likelihood of vaginal births, therefore reduces the need for caesarean sections and the use of forceps or vacuum during vaginal births. In addition, it reduces the need to use pain medications during labor, it shortens the duration of labor and improves women's satisfaction with care. It also improves Apgar scores (a measure of the physical condition of a newborn infant) of the newborns [53].

Moderate Exercise (Walk and Stretch)

Physical activity is a well-documented, viable therapeutic modality for chronic pain conditions with beneficial effects on pain, sleep, cognitive function and physical function. Alternatively, self-directed physical activity can be inexpensive, requiring minimal resources such as walking around one's neighborhood and home-based programs. Quite uniformly, low to moderate intensity exercise defined as 50-60% of maximum heart rate (maxHR) tends to improve chronic pain symptoms [54,55]. Exercise is effective for the management of chronic low back pain for up to 1 year after treatment and for fibromyalgia syndrome for up to 6 months [56]. An 8-week moderate intensity aerobic exercise intervention at 40%–60% of heart rate reserve combined with conventional physiotherapy, significantly reduced NSCLBP by 47% [57]. Muscle soreness that sometimes occurs with starting a new exercise subsided as the participants adapted to the new activities [58]. Combined training, which included aerobic and resistance exercises for eight months, succeeded in decreasing pain from breast cancer [59]. Many therapeutic programs proposed for painful conditions consist of physical therapy programs with mobilization, and about 70% of outpatients and inpatients are referred to physical therapy programs for painful conditions (mainly neck and low-back pain, lower-limb osteoarthritis, sports injuries, total joint replacement, upper-limb musculoskeletal disorders, inflammatory arthritis). The exercise and mobilization techniques of physical therapy include aerobic training, specific muscular strength exercises, active and passive mobilization, and proprioceptive techniques [57]. Prevalence of knee OA increases with age, ranging from 3% among those aged 45–54 years old to 44% in those at least 80 years old. These prevalence estimates are expected to increase as the US population continues to age and obesity rates rise. Therapeutic exercise is often recommended as a first-line conservative treatment for knee OA [60].

Heat/cold application

Superficial heating and cooling of tissues to provide pain relief in low to moderate levels of acute and chronic pain in adults [61]. Naturopathic physical therapy significantly improves foot functionality and pain scores in heel pain. Additionally, alternating compresses improve foot functionality scores [62]. RCTs have shown that heat-wrap therapy provides short-term reductions in pain and disability in patients with acute low back pain and provides significantly greater pain relief of DOMS than does cold therapy [63]. Cryotherapy (the use of extreme cold in surgery or other medical treatment) and thermotherapy as therapeutic methods in the patients with acute and chronic low back pain had an equal effect on relieving the pain based on evaluative and descriptive measures [64]. Application of cold promotes relief of pricking pain sensation and suppression of autonomic responses, and that application of heat has no such effect [56]. In the United States, 75 % of patients with low back pain are treated with heating therapy and 7 % with cooling therapy. cooling therapy decreases tissue blood flow due to vasoconstriction, and that it also reduces tissue metabolism, oxygen utilization, and inflammation. Cooling therapy

decreases the velocity of nerve conduction in superficial tissues by slowing the firing of muscle spindle afferents and reflex responses, thus decreasing muscle spasms and pain. Use of cooling therapy for musculoskeletal problems can also reduce intake of painkillers because it reduces pain and body fluid penetration [65]. Pain after thoracotomy is probably the most severe pain experienced after surgeries and patients who underwent cardiac surgeries report having most severe pain while coughing and deep breathing. Pain was significantly decreased with the use of cold gel packs [66]. Usually the chest tube removal (CTR) has been described as one of the worst experiences by patients in the intensive care unit. Regarding the relaxation and cold application methods showed relatively equal effects on reducing the pain owing to CTR [67] (Figure 8).

Figure 8: Essential oils for aromatherapy. Alternative therapies are frequently used to relieve various symptoms of patients. They are used instead of standard medical treatments and alternative therapies are distinct from complementary medicine which is meant to accompany, not to replace, standard medical practices. Aromatherapy is usually used in combination with massage, can successfully treat pain when combined with conventional treatments. Additionally, the cost associated with aromatherapy is far less than the cost associated with standard pain management treatment (Source: Lakhan SE, Sheafer H, Tepper D. The Effectiveness of Aromatherapy in Reducing Pain: A Systematic Review and Meta-Analysis. Pain Res Treat. 2016; 2016:8158693).

Lotions/massage therapy

Therapeutic massage is a CIM therapy which involved manipulation of the soft tissue of whole-body areas to bring about generalized improvements in health [68,69]. Reflexology treatment consists of massage of the disordered reflex zones. Massage is mainly used to promote relaxation, treat painful muscular conditions; it can also foster communication, including decreased stress (and decreased cortisol), improved sleep patterns, and enhanced immune function, [69-71]. The massage group had lower pain and anxiety levels and shorter duration of labor; lower pain than the ultrasound participants and reported greater functional status as measured on the foot and ankle pain assessment; significant improvement was noted for knee arthritis and pelvic (after 8 weeks therapy) pain; immediate reductions in neck pain [72]. Aromatherapy refers to the medicinal or therapeutic use of essential oils absorbed through the skin or olfactory system (although rare phototoxicity and carcinogenicity reported), is used as a part of nursing in many countries including Switzerland, Germany, England, Canada, and America [73-76]. Aromatherapy with orange oil can relieve pain in patients with fractured limbs. A study has shown that edible oil of orange can reduce breast pain caused by premenstrual syndrome [76]. The essential oils rosemary, geranium, lavender, eucalyptus, and chamomile can be safely used by nurses in the clinical setting, if applicable [77] (Figure 9,Table 6).

Figure 9: Ayurveda Massage. (Source: Healing with Ayurvedic Herbs | Panchakarma Treatment Centre in Croydon London).

Table 6: Massage Techniques [68].

Effleurage	Gentle stroking along the length of a muscle
Petrissage	Pressure applied across the width of a muscle
Friction	Deep massage applied by circular motions of the thumbs or fingertips
Kneading	Squeezing across the width of a muscle
Tapotement	Light slaps or karate chops

Meditation

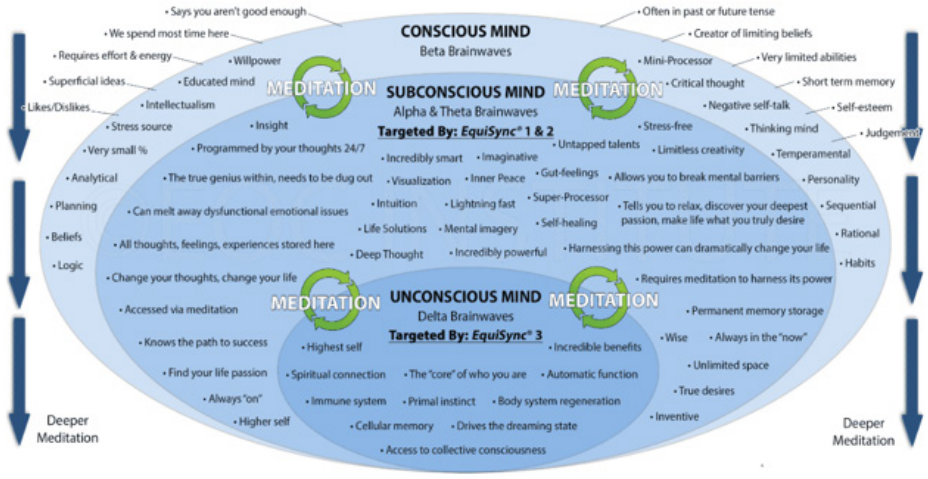

Figure 10: Anatomy of Mind: Meditation gives access to most powerful layers of mind (Results may vary from person to person). Hypnosis has been pragmatically used for limited therapeutic targets, while Eastern meditation has much wider philosophical and existential implications, aiming for a radical liberation from all illusions, attachments, suffering and pain. The available data on the history, phenomenology, and neuropsychology of hypnosis and meditation show several common features, such as the following: (a) induction based on focused attention; (b) capability to reach an intentional control of both biologic-somatic activities and conscious-unconscious processes. The Hypnotic Brain can serve as a way to tap neurocognitive questions and our cognitive assays can in turn shed new light on the neural bases of hypnosis. Discrete meditative styles are likely to target different neurodynamic patterns. Recent findings emphasize increased attentional resources activating the attentional and salience networks with coherent perception. Cognitive and emotional equanimity gives rise to a eudemonic state, made of calm, resilience and stability, readiness to express compassion and empathy, a main goal of Buddhist practices. Structural changes in gray matter of key areas of the brain involved in learning processes suggest that these skills can be learned through practice. Hypnosis and Meditation represent two important, historical and influential landmarks of Western and Eastern civilization and culture respectively (Source: De Benedittis G. Neural mechanisms of hypnosis and meditation. J Physiol Paris. 2015 Dec;109(4-6):152-164. doi: 10.1016/j.jphysparis.2015.11.001. Epub 2015 Nov 10. Review. PubMed PMID: 26554845).

Mindfulness meditation was introduced as a clinical intervention for conditions such as chronic pain and anxiety in 1979 [78]. Chronic pain patients increasingly seek treatment through mindfulness meditation, thought to work by refocusing the mind on the present and increasing awareness of one's external surroundings and inner sensations, allowing the individual to step back and reframe experiences [79]. Meditation–based interventions improve pain symptomology across a wide spectrum of pain-related disorders, including fibromyalgia, migraine, chronic pelvic pain [80]. Meditation, after the four-session intervention, during noxious heat produced a mean 40% reduction in pain intensity and 57% reduction in pain unpleasantness ratings [81]. A variety of factors are now known to either increase or decrease pain-related brain activation, including: predictive cues, distraction, attention, expectation, beliefs, placebo, hypnosis, stress, anxiety, mood and emotional state [82]. Focused attention (FA), also known Shamatha (from Sanskrit), is associated with maintaining focus on a specific object, often the changing sensation or flow of the breath or an external object [83]. By contrast, open monitoring (OM), or Vipassana (Sanskrit translation), is associated with a non-directed acknowledgement of any sensory, emotional or cognitive event that arises in the mind. Zen meditation is considered to be one form of OM practice [84] (Figure 10).

Music, art, or drama therapy

Music is one of a number of non-pharmacological methods of relieving chronic pain, along with exercise and cognitive behavioral therapy, that have been found to be effective in RCTs [85]. VMT may be effective in building essential stepping stones for chronic pain management, namely developing:

1) A positive relationship with one's self

2) Enhanced self-efficacy

3) Motivation and empowerment to take charge of one's pain management

4) Renewed social engagement [86].

The U sequence is a music therapy technique specifically developed for pain management [87,88]. A single session of music therapy is effective in significantly reducing cancer pain when used along with standard palliative care in cancer patients with moderate to severe pain, chronic pain and anxiety/depression, by altering affective, cognitive, and sensory processes, music may decrease pain perception by distraction, change in mood, increased control, use of prior skills, and relaxation, reduces opioid requirements, improve QoL [89-97]. Cepeda et al. [92] shows that music therapy was best for short term pain after surgery [93]. Music is expressive; individuals may trigger a variety of emotions through creating music in groups or individually. Via its ability to modify the affective or cognitive state of the listener, music can be adapted to function as a behavioral intervention for pain [95]. Tolstoy said that music is the shorthand of emotion, and Congreve explained that music has charms to soothe a savage breast [98]. As a treatment adjuvant to reduce chronic pain in FM, and FM-as-

sociated sleep disturbances and increase functional mobility thereby reducing the risk of disability. However, effectiveness is higher when combined with aerobic exercise, which brings about further improvements in quality of life and balance [97,99,100]. Dramatherapy made an important contribution to the healthy adjustment of some patients both to hospital life and to acquired disability [101-103] (Figure 11)

Figure 11: Music Therapy: Pain Management Part 2 | Michael Tyrrell. In the UK, music therapists are trained to master's level and are registered with Health and Care Professions Council as allied health professionals. Aristotle recognized the innate ability of melodies to surpass "feelings such as pity and fear, or enthusiasm," and thus "heal and purify the soul." The Greeks identified Apollo as the father of both healing and music, alongside his many other accolades (as God of light, sun, truth, prophecy, plague and poetry). Two physicians famed for using their musical abilities to implement medical achievements described chest percussion. Operating room is a quiet place and serious that there will be any extra noise to the distraction and interfere with verbal communication between people. Music is a free way to improve patients stress and pain before and during surgery. Although there isn't enough evidence in order to draw a net conclusion about the effect of music in operating rooms (Vahed N, Kabiri N, Oskouei MM, Gavgani VZ, Khatooni AA, Sadooghi N. 130: THE EFFECT OF MUSIC IN OPERATING ROOM: A SYSTEMATIC REVIEW. BMJ Open. 2017;7(Suppl 1): bmjopen-2016-015415.130. Published 2017 Feb 8. doi:10.1136/bmjopen-2016-015415.130).

Expressive Writing Intervention (EWI)

Writing increases health and wellness in varied ways. individuals who have written about their own traumatic experiences exhibit statistically significant improvements in various measures of physical health, reductions in visits to physicians, and better immune system functioning [103]. Written emotional disclosure in adolescents with recurrent abdominal pain, and anger letter writing in adults with heterogeneous pain may be beneficial. Most disclosures of patients with RA were about the daily stress of the disease or other publicly known stressors (e.g., divorce, death of loved ones) rather than private or stigmatized stressors, which might have been more powerful to address [104]. Improved physical symptoms and reduced healthcare utilization in people with colorectal, breast, or prostate cancer and reduction in depressive symptoms, trauma-related cognitions and general behavioral problems in children with post-traumatic stress disorder also reported [105]. EWI may have a significantly positive impact on the physical health but not the psychological health in BC patients, but this benefit may not last long [106]. Patients with IBS treated with psychological therapy had not only reduced pain and anxiety but also reduced activity of the cingulate cortex and Para hippocampal gyrus [107]. Positive expressive writing may also be beneficial to those with musculoskeletal pain. Positive writing may be useful to the extent that it increases self-compassion and self-efficacy [108]. EWI is shown to be an effective intervention to improve QoL for Chinese-American breast cancer survivors [109]. A positive effect of expressive disclosure specifically on anxiety and specifically for young adults who were highly emotionally expressive [110]. EWI had a significant impact on reducing risk of eating pathology in female students and distress/depression during ART therapy of infertile women [111,112]. EWI with clinical samples shows potential benefit of written time management for stressed caregivers [113].

Pastor

The Pain Assessment Screening Tool and Outcomes Registry (PASTOR) is a 20-30-minute survey that produces a comprehensive 3-page clinician report of a patient's chronic pain. PASTOR was developed as a direct result of the PMTF recommendations; it is designed to provide an outcomes registry to improve evidence-based decision making by health care providers and to facilitate pain research [114]. PASTOR incorporates the DVPRS, pain interference assessment, neuropathic pain scale, headache assessment, and patient-defined activity goals. In addition, PASTOR includes screens for the following conditions: PTSD, anxiety, depression, and alcohol misuse. Additional pain correlates including global health, fatigue, satisfaction with social roles, anger, sleep-related impairment, and physical function are also assessed [115-117]. It uses the computerized adaptive learning system of the NIH PROMIS which contains a large, validated databank of patient-reported outcome surveys. PASTOR serves two major purposes: first, it collects actionable information that can be used by clinicians to assess response to treatment and to guide pain management; and second, when aggregated from large numbers of respondents, it can identify best clinical practices [117-119]. PROMIS Pain Interference (PI) scores was a superior tool to gauge a patient's preoperative level of pain and functional ability compared to NPRS in foot and ankle patients [114].

Pet Therapy

Figure 12: Hospitalized kid on animal visit. Understanding whether AAA is safe and effective for pediatric cancer patients is critical, especially because of concern about infection in immunosuppressed persons. Conducting AAA research in pediatric oncology requires understanding current regulations and variations in practice. Knowledge of regulations helps us understand elements required for intervention protocols (e.g., hand-cleaning), whereas knowledge of practice variation can help us identify research opportunities (Source: Chubak J. Therapy-dog visits for kids with cancer: A safe way to induce smiles? Web Kaiser Permanente Washington Health Research Institute July 6, 2017.

Pets provide companionship, unconditional love, and joy. For those with chronic pain, pets can give their owners even more [120]. According to the Delta Society (Non-profit), pets decrease feelings of depression, loneliness, and isolation. Pets may also be able to do your heart some good — they are credited with lowering blood pressure and cholesterol [121]. The American Veterinary Medical Association classifies therapeutic animal assisted interventions (AAI) into three categories: animal assisted activities (AAA) that utilize companion animals; animal assisted therapy (AAT) that utilizes therapy animals and service animal programs (SAP) that utilize service animals [122]. Therapy dog visits in an outpatient setting can provide significant reduction in pain and emotional distress for chronic pain patients [123]. Reductions in measures of cardiovascular stress, improvements in neurophysiological stress markers (e.g., cortisol), increases in endorphins, and enhancement of immune factors is also reported. An average 12 minutes exposure to a therapy dog reduces anxiety in 34% of fibromyalgia patients, together with reductions in pain and improvements in mood [124]. Patients with major joint replacement exposed to dog therapy required less pain medication than controls [125]. The ED simultaneously represents an environment that has great need for the potential benefits of animal assisted therapy, but also presents unique challenges to its implementation. In one ED, 93% of all patients indicated desire to see a therapy dog [126]. Therapy dogs offer a novel and useful complementary therapy for children undergoing surgical procedures [122]. AAA has the potential to benefit children with cancer because pediatric oncology patients often suffer from distress due to physical examinations, venipuncture, chemotherapy infusions, spinal taps, surgery, hospitalization, pain, fear of medical procedures, unpleasant physical symptoms, uncertainty, and worry about death [127]. Patients with brain tumors face serious and unique challenges with neurologic and neuropsychological problems that are specific to the location of the tumor and just not the systemic symptoms of the cancer [127,128]. Pet therapy significantly increases patients' overall feeling of wellbeing and reduces anxiety about future uncertainty [129] (Figure 12).

Positioning

Simply assisting a patient to change position in the bed or chair or while ambulating can improve comfort. Additionally, appropriate body alignment and support of extremities can improve patient comfort and outlook. Keeping items within reach also makes a patient more comfortable. Back pain is relieved by several positions. The first is to place the head and trunk at 20° to 30° angle. Wedge pillows are used to accomplish this. Then place one or two pillows under the knees, if it is a hospital bed, this is done easily without pillows. Moving the arms and legs while keeping the trunk still can make symptoms worse. For example, lifting a leg up while lying on the back tended to cause complaints of back and leg pain. Some patients also had increased back pain when lying face down and bending the knee or turning the hip in or out. The patient can usually do it himself using the bed controls. Pressure reduction occurred in the sacral region with the pillow and wedge systems resulted in increased pressures in the posterior-lateral regions of the buttocks and thighs. When using off-loading devices, consideration should be given to all factors, including tissue interface pressures on the sacrum, increased pressures on other body locations, and the likelihood that these increased pressures will result in tissue damage. The pain is worse when changing positions or when coughing or sneezing in low back pain. Ensuring that the over-bed table, the telephone, the nurse call button, and the PCA control button are all within a patient's reach not only decreases repeat demands from the patient, but also decreases patient anxiety. The following are reasons for changing a patient's position:

a) To promote comfort and relaxation.

b) To promote good circulation.

c) To improve lung function.

d) To relieve pressure on skin and prevent skin breakdown (pressure sores)

e) To prevent loss of muscle tone

f) To prevent atrophy and contractures

g) To prevent edema (swelling) [130-136] (Table 7)

Table 7: Differential Diagnosis of Low Back Pain [136].

Mechanical Low Back Pain	Nonmechanical Spine Disease	Visceral Disease
Lumbar strain or sprain†	**Neoplasia**	**Pelvic organs**
Degenerative disease Disks (spondylosis) Facet joints‡ Diffuse idiopathic skeletal hyperostosis‡	Metastatic carcinoma Multiple myeloma Lymphoma and leukemia Spinal cord tumors Retroperitoneal tumors	Prostatitis Endometriosis Chronic pelvic inflammatory disease
Spondylolysis‡ § Spondylolisthesis¶ Herniated disk Spinal stenosis Osteoporosis with compression fracture Fractures Paget's disease	**Infection**	**Renal disease**
	Osteomyelitis Septic discitis Paraspinal or epidural abscess Endocarditis	Nephrolithiasis Pyelonephritis Perinephric abscess
	Inflammatory arthritis	**Vascular disease**
	Ankylosing spondylitis Reiter's syndrome Psoriatic spondylitis Inflammatory bowel disease Polymyalgia rheumatica	Abdominal aortic aneurysm Aortoiliac disease
Congenital disease Severe scoliosis Severe scoliosis		**Gastrointestinal disease** Pancreatitis Cholecystitis Perforated bowel

†A variety of terms are used to refer to muscle or ligament strains or sprains of the low back including lumbago, facet joint syndrome, sacroiliac syndromes, segmental or somatic dysfunction, fibromyalgia, and myofascial syndrome.

‡The relationship between symptoms and objective findings for these conditions is not clearly established.

§Spondylolysis is a defect in the pars interarticularis without vertebral slippage.

¶Spondylolisthesis is anterior displacement of one vertebra, typically L5, over the one beneath it.

Hypnosis

Most of the hypnosis interventions for chronic pain include instructions in self-hypnosis. Hypnosis interventions consistently produce significant decreases in pain associated with a variety of chronic-pain problems. Also, hypnosis was generally found to be more effective than nonhypnotic interventions such as attention, physical therapy, and education [137]. Medical uses of hypnosis in dermatology includes reducing discomfort from itching or skin pain, altering ingrained dysfunctional habits such as scratching etc. [138] (Figure 13).

Figure 13: Use of Hypnosis in the Treatment of Pain. There are three elements in hypnosis; absorption, dissociation, and suggestibility. Absorption is immersing deeply into perception, imagination, or an abstract experience. Those who have a tendency to easily experience absorption are more hypnotizable than people with no experience. Dissociation is the separating of the elements of the mind and behavior, for example when recalling an autobiographical memory, it is similar to the state of dreaming where the subject is both the observer, as well as the main character, simultaneously. There could be a behavior in the state of unconsciousness, or an experience of sensation of the other body parts separated to other parts of the body. Suggestibility is that the subject easily conforms to the therapist's directions during hypnosis. However, this does not mean that the subject has completely lost his or her volition. Rather, as the subject is immersed in a state of hypnosis, the subject's judgment is reserved for a short time (Source: Lee JS, Pyun YD. Use of hypnosis in the treatment of pain. Korean J Pain. 2012;25(2):75-80).

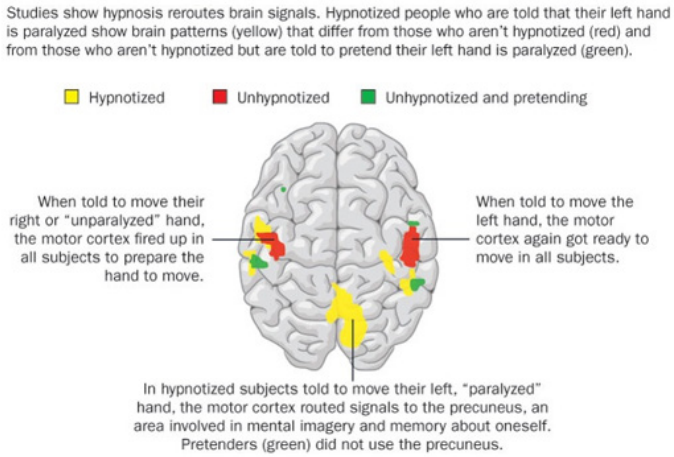

Figure 14: Changes in Different Areas in Brain After Hypnosis. Three general conclusions can be drawn from this body of work. First, hypnosis and hypnotic analgesia suggestions have been shown to affect virtually all of the neurophysiological processes that underlie the experience of pain, from those in the periphery to those in the spinothalamic tract and numerous cortical areas. Second, the specific effects of hypnosis on brain activity depend on the wording of the hypnotic suggestions. Last, although people can respond to suggestions for pain relief without a hypnotic induction, the efficacy of analgesia suggestions is enhanced when they are preceded by this step. This latter finding might be related to neurophysiological changes that occur with a hypnotic induction, which are thought to reduce overall monitoring and executive functioning activities (Source: 136. Jensen MP, Day MA, Miró J. Neuromodulatory treatments for chronic pain: efficacy and mechanisms. Nat Rev Neurol. 2014 Mar;10(3):167-78. doi: 10.1038/nrneurol.2014.12. Epub 2014 Feb 18. Review. PubMed PMID: 24535464; PubMed Central PMCID: PMC5652321).

The brain areas that are activated when pain is experienced are the thalamus, primary somatosensory cortex (SI), secondary somatosensory cortex (SII), insula, forebrain (e.g. prefrontal cortex), amygdale, and anterior cingulated cortex (ACC) [139-141]. These brain areas are called the neuromatrix. ACC is responsible for the emotions (activated during love, affection and notably emotion) [139,142]. During hypnosis, when an unpleasantness due to pain is suggested to increase or decrease, the unpleasantness changed in accordance to the suggestions, and the ACC activity also changed accordingly [139,142-144]. However, there were no changes in pain intensity and brain activity including SI and SII [139]. The potential benefits of combining pain education (PE) with clinical hypnosis (CH) in the first trial showing that additional use of hypnosis with PE results in improved outcomes over PE alone in patients with chronic nonspecific low back pain [145]. Hypnosis has been used in ophthalmic surgery for many years, and several cases of successful hypnosis application have been reported. Alleviation of pain, especially for patients who experienced obvious pain during the first-eye surgery also reported [146]. Patients with severe chronic diseases and advanced cancer receiving palliative care, have a complex range of pain and anxiety that can arise early in the course of illness. Clinical hypnosis can be considered an effective adjuvant therapy for pain and anxiety control in cancer as well as in severe chronic diseases for patients receiving palliative care [147] (Figure 14,Table 8).

Table 8: Counseling Points for the Patient with Neuropathic Pain [314].
A combination of treatment strategies is essential to achieve some degree of relief from chronic pain because the pain is the result of multiple causes.
Understanding medications, dosing schedules, side effects. Track of multiple medications may be required.
Realizing that medications may not be FDA-approved for treatment of neuropathic pain, and reference information may not be readily available.
Cautions about using alternative or natural medicines to provide relief. These usually are not effective and can be expensive.
Physical therapy, exercise, and psychological treatments are important to the treatment plan. Keeping appointments and being patient with expectations.
Setting reasonable goals for pain relief. Pain most likely will not be able to be completely cured.
Understanding neuropathic pain. Being knowledgeable about condition gives an opportunity to have input into the treatment plan.
Becoming proactive about health, and to achieve successes.

Electrical Stimulation

Electrical stimulation can relieve some severe and otherwise persisting pains. At its best it can be associated with either a gradual reduction in the pain or an increased ability by the patient to control his suffering. It seems particularly appropriate for use in the field of benign persistent pain [148]. It involves using a device to send a gentle electric current to nerves or muscles. This can help treat pain by interrupting or blocking the pain signals [149]. These devices are generally safe. However, they involve sending electrical impulses though body. So, it's important to talk with physicians if patient has a pacemaker, another implanted device, is pregnant, with epilepsy, or having a heart problem [150]. It might have been prudent to separate these currents according to their primary uses in physiotherapy practice, rather than combining them together. TENS and IFC are used primarily for pain relief; HVPC is used for wound care and sometimes for pain relief; and NMES is used for muscle-fiber recruitment. NMES can be used safely and effectively in patients with cancer, chronic obstructive pulmonary disease, and heart disease [150,151]. Electrical stimulation often is used to augment physical therapy program after an injury or illness; it should not be the only treatment received when attending physical therapy [152]. There are different ES forms, including transcutaneous electrical nerve stimulation (TENS), neuromuscular electrical stimulation (NMES), interferential current (IFC), pulsed

electrical stimulation (PES), noninvasive interactive neurostimulation (NIN), Iontophoresis [152,153]. Broader types include: Transcutaneous electrical stimulation (TENS); Implanted electric nerve stimulation (e.g. PNS); Deep brain or spinal cord stimulation [149]. The recent advancements include improvement in ultrasound technologies, integration of ultrasound into clinical practice, percutaneous implantation techniques, smaller devices, and rechargeable and larger-capacity batteries [154] (Figure 15).

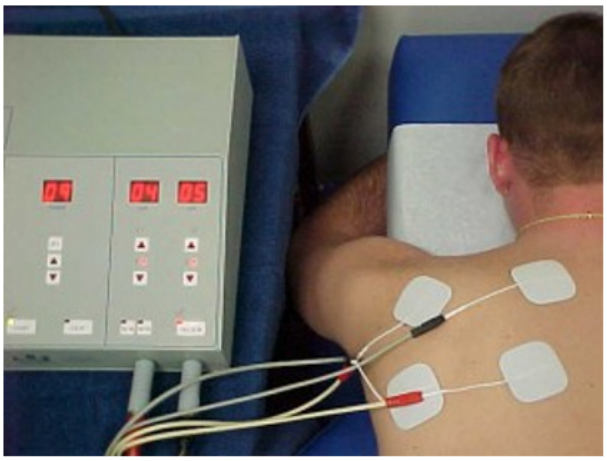

Figure 15: Electric Stimulation Therapy. Electrical stimulation therapy involves placing adhesive pads with electrodes on the patient's skin in order to direct a controlled electrical current through the body. The electrodes are placed such that the electrical current reaches the affected area of the body and causes a contraction of a targeted single muscle or group of muscles. While it may seem scary to send electricity through the body, it is actually replicating the electrical impulses that occur in the body during normal movement and exercise. Most patients do not feel any pain while receiving the treatment. The produced contraction causes an increase in blood supply to the targeted area, which can result in improved muscle strength and increased healing. Depending on the severity of the condition, the electrical stimulation can be increased for a more forceful contraction or decreased for a gentler contraction. An additional benefit of this treatment is that the nerves in the affected area are stimulated, which can block pain signals from the nerves to the brain. This is why electric stimulation therapy is often used to help treat chronic conditions, but many acute conditions can be effectively treated as well. It is also thought that the electrical stimulation causes the body to produce endorphins, which naturally provide pain relief (Source: Web Back & Body Medical. Electric Stimulation Therapy).

Implantable Peripheral Nerve Stimulation (PNS)

The peripheral nervous system includes pathways outside of the spinal cord, specifically various plexuses and peripheral nerves. Peripherally implanted nerve stimulation entails the placement of electrodes on a selected peripheral nerve. The stimulating electrode array is connected to an implanted pulse generator [155]. PNS has been shown to be efficacious in several chronic pain conditions including trigeminal neuropathic pain, episodic cluster headache (supraorbital nerve stimulation), chronic migraine/headache disorders (occipital nerve stimulation), fibromyalgia (C2 area stimulation), postherpetic neuralgia, complex regional pain syndrome type I and type II, isolated peripheral neuropathy, ilioinguinal, iliohypogastric, and lateral femoral cutaneous neuralgia, back pain, foot pain (tibial nerve stimulation), and coccydynia [154]. Post-stroke HSP is highly prevalent. Of those who suffer from HSP, up to 75% report moderate to severe pain with a third refractory to available treatments [156,157]. Data suggest that surface electrical stimulation (ES) is efficacious for treating HSP. However, it is not well-tolerated and requires skilled personnel to maintain [156]. The mechanism of PNS-mediated pain relief may include improvement in biomechanics of the glenohumeral joint and reversal of central sensitization. Reduction in pain, reduction in pain interference, and improved pain-free external rotation ROM without serious adverse events reported [156,158]. The use of ultrasound technology during implantation allows for percutaneous placement of the PNS electrode [159] and almost eliminates the need for skin incision and tissue dissection [160]. Currently, extra-neural electrodes have proven safe for chronic applications while invasiveness and long-term stability of intraneural electrode remain challenging for permanent implantation. Safety limits of stimulation parameters are still predominantly described in terms of electric charge [161]. Compared to the conventional battery-powered system, WINeRS (under research) can be used in closed-loop recording and stimulation experiments over extended periods without adding the burden of carrying batteries [162]. However, the criteria for patient selection for conventional PNS are:

a) Clear-cut etiology and corrected pathology (eg. Nerve entrapment syndrome)

b) Only patients with intolerable pain despite exercise, medication and TENS

c) Pain consistent with the sensory distribution of a single peripheral nerve

d) A positive diagnostic peripheral nerve block

e) Exclusion of nerve entrapment neuropathies

f) The patient is free of major psychological or psychiatric disease [154,163]

Contraindications for the use of PNS mainly relate to surgical risk and include:

i. Coagulopathy

ii. Infection in the surgical site

iii. Psychiatric illness

iv. A failed diagnostic trial

v. Requirement of periodic MRIs, such as for cancer patients

vi. Complete sensory loss [154] (Figure 16).

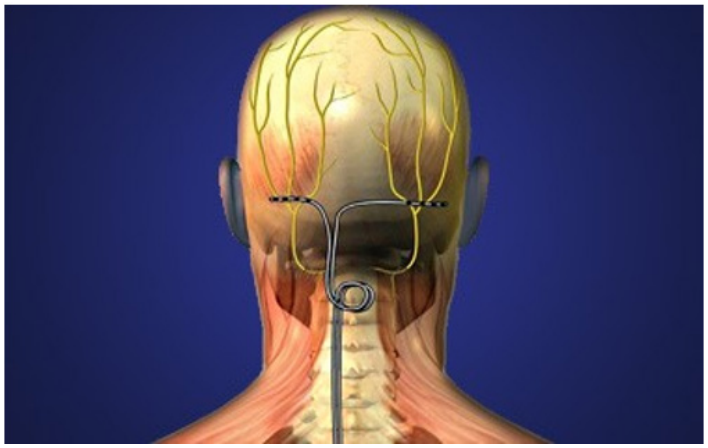

Figure 16: Peripheral Nerve Stimulation (PNS). Following a successful trial, a permanent device, consisting of thin wires with electrical leads on their tips, is placed through a needle under the skin. In addition, a battery is placed under the skin through a small incision. Everything is small enough to remain hidden under the skin. The system can be turned on or off by the patient using a remote control. In addition to nerve injuries, a peripheral nerve stimulator implant is often used to treat conditions such as CRPS (complex regional pain syndrome) and lower back pain. (Source: Web National Spine & Pain Centers. Peripheral Nerve Stimulation (PNS) Interrupts Pain Signals of Damaged Nerves).

Neuromuscular Electrical Stimulation (NMES)

In sports, NMES has been used for muscle strengthening, maintenance of muscle mass and strength during prolonged periods of immobilization, selective muscle retraining, and the control of edema. A wide variety of stimulators, including the burst-modulated alternating current ('Russian stimulator'), twin-spiked monophasic pulsed current and biphasic pulsed current stimulators, have been used to produce these effects [164]. It is often used to "re-train" or "re-educate" a muscle to function and to build strength after a surgery or period of disuse [165]. During short-term disuse, NMES represents an effective interventional strategy to prevent the loss of muscle mass by increasing muscle protein synthesis rates [166]. Programs of NMES appear to be acceptable to patients and have led to improvements in muscle function, exercise capacity, and quality of life after Cardiovascular surgery [167,168]. NMES can be safely implemented even in patients immediately after cardiovascular surgery and it helps to regain muscle strength only when applied for a sufficient number of days [169,170]. It is safe for critically ill patients; however, it should be applied by duly trained professionals and with proper evidence-based parameters. Recent studies with variable methodological designs have shown that NMES is safe, feasible and beneficial for patients admitted to the ICU but available data are still inconclusive due to the heterogeneity of protocols and the small sample sizes [171]. A packaged intervention of TMT plus NMES may be a means of addressing not only LBP, but also impaired physical function and resultant disability, but studies among older adults have been limited [172]. Prevalence of postpartum LBP (PPLBP) has been reported to be 35% in the first month after the delivery, it is still the most prevalent painful condition, and is considered as a serious problem by one-third of pregnant women. Limited data of using NMES for treating patients with PPLBP are available and it is ineffective to patients with PPLBP [173]. It might not benefit for patients with wrist dysfunction after AIS after 4-week treatment [174]. Although clinical meaning reported improvement is difficult to interpret, a 20% improvement in swallowing performance following treatment reported in an older study in use of NMES in the rehabilitation of swallowing disorders [175]. It is effective in female Chinese patients with EAP after 10-week treatment. Further studies are still needed to warrant this result [15]. CUR is a very tricky disorder, involving inability to voluntarily urinate for patients with TBI. NMES could not relieve symptoms of Chinese patients with CUR after TBI, as well as improve their quality of life after 8 weeks of treatment [176]. NMES is a valuable adjunct in patients with dysphagia and in patients with vocal fold paresis [177]. Combined NMES/TENS may be a valuable adjunct in the management of chronic back pain. Further research investigating the effectiveness of both NMES and combined NMES/TENS seems warranted [178]. No study found using NMES for the management in patients with NPP after SCI [179]. The efficacy of NMES being distinctly superior to that of TENS in maintaining long-term analgesia in HSP. However, NMES was not more efficacious than the TENS in improving the shoulder joint mobility, upper limb function, spasticity, the ability of daily life activity, and stroke-specific quality of life in HSP patients [180]. A recent trial found insufficient and inconclusive evidence from RCTs to inform on the role of NMES for treating people with PFP in current clinical practice [181]. NMES training appears to offset the changes in quadriceps structure and function, as well as improve the health status in patients with knee OA [182,183]. NMES was not found effective for patients with CLBP after 4-week treatment [184] (Figure 17).

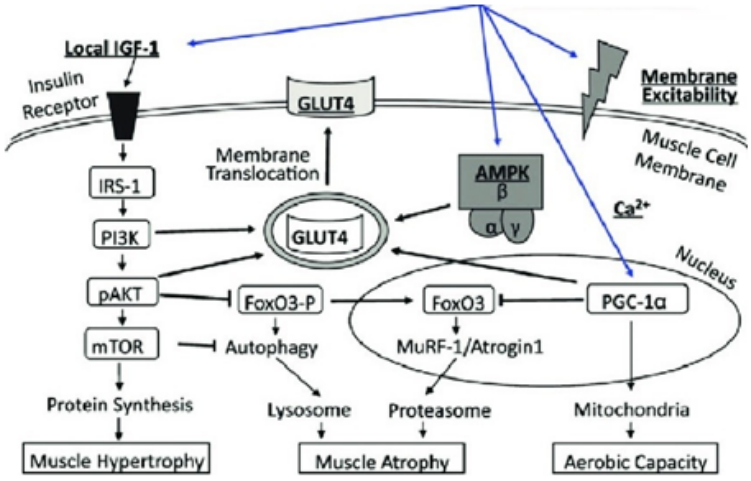

Figure 17: Repeated Muscle Contraction by NMES. Suggested beneficial effects of neuromuscular electrical stimulation (NMES) with regard to muscle hypertrophy, atrophy, aerobic capacity, membrane excitability, and membrane translocation of GLUT4. NMES may preserve membrane excitability. Membrane translocation of GLUT4 is regulated by IGF-1, AMPK, PGC-1α, and its downstream targets, which may all be affected by NMES. Atrophy gene expression (MuRF-1, atrogin-1) increases upon dephosphorylating of FOXO3 transcription factors, which is inhibited by downstream insulin signaling (Source: Yuki Iida and Kunihiro Sakuma. Chapter 16. Skeletal Muscle Dysfunction in Critical Illness. In: Physical Disabilities - Therapeutic Implications http://dx.doi.org/10.5772/intechopen.69051).

Transcutaneous Electrical Nerve Stimulation (TENS)

Table 9: Exclusion criteria/contraindications for the use of a TENS unit [193].
TENS unit cannot be placed over the eyes.
TENS unit electrodes cannot be placed on opposite sides of the head that would result in a trans-cerebral current.
TENS unit electrodes cannot be placed on the chest and back that would result in a transthoracic current.
TENS units cannot be placed on the anterior neck due to the possibility of a vasovagal event or laryngospasm.
TENS units cannot be placed internally.
TENS unit electrodes cannot be placed directly over the spinal column.
TENS unit electrodes should not be placed near any sort of implantable device (spinal stimulator, pacemaker, etc.) where current from the TENS would interfere with the device.
For pacemakers or pacemaker/defibrillators, a TENS unit must be placed at least six inches away from the pacemaker AND during initial TENS unit placement, the patient should be on a cardiac monitor to watch for any interference.
TENS units should not be used over the uterus in pregnant women.
Exclusion criteria/contraindications for the use of a TENS unit [193].

TENS, is a modality that uses electric current to activate nerves for therapeutic reasons. The TENS unit is a small device, often battery-operated, which can sometimes even fit into a pocket. It utilizes electrodes placed on the skin and which connect to the unit via wires to address a targeted therapeutic goal. The units are said to be titratable, permitting for a high degree of user tolerance with few side effects. Compared to many medications, the device is free from the risk of overdose. TENS units are often highly adjustable, allowing the user to control pulse width, intensity, and frequency. Low frequency of < 10Hz in conjunction with high intensity is used to produce muscle contractions. High frequencies of > 50Hz are used with low intensity to produce paresthesia without muscle contractions [185-191]. IASP works on two types of TENS: high frequency TENS [50-100Hz, pulse per second (pps)], with low intensity (paresthesia, non-painful), pulse duration (50-200μs); and low frequency TENS (<10pps), with high intensity (to tolerance threshold), pulse duration (100-400μs). What makes TENS worthwhile is that this technique, while substantially relieving acute and chronic pain, is noninvasive, inexpensive, safe and easy to use [192] (Table 9).

Table 10: General Features of TENS [185,316-320].
It is a non-invasive, inexpensive, self-administered technique to relieve pain.
There are few side effects and no potential for overdose so patients can titrate the treatment as required.
TENS techniques include conventional TENS, acupuncture-like TENS and intense TENS. In general, conventional TENS is used in the first instance.
The purpose of conventional TENS is to selectively activate large diameter non-noxious afferents (A-beta) to reduce nociceptor cell activity and sensitization at a segmental level in the central nervous system.
Pain relief with conventional TENS is rapid in onset and offset and is maximal when the patient experiences a strong but non-painful paraesthesia beneath the electrodes. Therefore, patients may need to administer TENS throughout the day.
Clinical experience suggests that TENS may be beneficial as an adjunct to pharmacotherapy for acute pain although systematic reviews are conflicting. Clinical experience and systematic reviews suggest that TENS is beneficial for chronic pain.

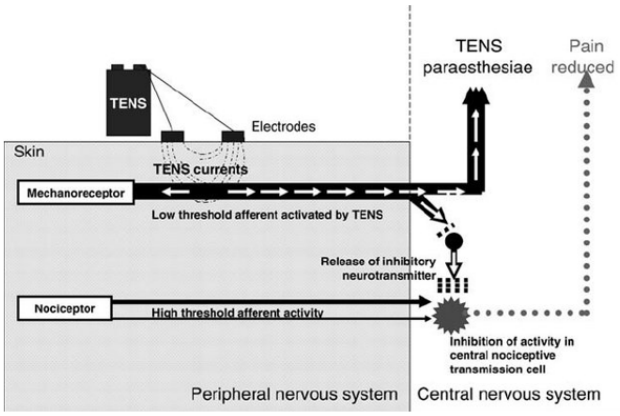

Figure 18: Postulated mechanisms of action for TENS-induced analgesia. TENS activates a complex neuronal network to result in a reduction in pain. TENS reduces hyperalgesia through both peripheral and central mechanisms which may involve: (1) Neurotransmitters & receptors that mediate TENS analgesia: HF TENS produces analgesia by activating endogenous inhibitory mechanisms in the central nervous system involving opioid GABA, and muscarinic receptors. (2) Reduction in central excitability: HF TENS also reduces central neuron sensitization and release of the excitatory neurotransmitters glutamate and substance P in the spinal cord dorsal horn in animals with inflammation. (3) Peripheral mechanisms: Some of the analgesic effects of TENS are mediated through peripheral adrenergic receptors (Source: Vance CG, Dailey DL, Rakel BA, Sluka KA. Using TENS for pain control: the state of the evidence. Pain Manag. 2014;4(3):197-209).

TENS units appeared to be effective in ED for reducing pain [193]. TENS is useful and safe adjuvant in spinal cord injury patients for the management of neuropathic pain [12]. There is strong evidence that TENS as an adjunct is effective in reducing lower limb spasticity when applied for more than 30 minutes over nerve or muscle belly in chronic stroke survivors [194]. Repeated applications of TENS as an adjunct therapy for improving walking capacity and reducing spasticity in the same population [195]. After 6-week treatment, patients with AS did not show more promising outcomes in pain reduction [196]. TENS and IFC have similar global effects on acute/chronic pain and positive effects on function in both WOMAC and RMDQ questionnaires [197]. TENS is effective in reducing pain and improving patients' QoL in cases of ICO. TENS is an easy-to-use, effective, noninvasive, and simple method for ICO-associated pain control and QoL improvement [18]. It has the potential to be a valuable therapeutic tool for women FSD in women without bladder problems [198]. It has been used for more than 45 years. However, despite all these advantages, there has been very little research into the therapeutic effects of TENS on brain activity [192]. Gamma band is a kind of brain wave which consists of very rapid oscillations (>30Hz) [199]. Moreover, it has been found that gamma band has an important role in pain perception as well as pain processing [200-202]. High frequency TENS could reduce the enhanced gamma band activity after inducing tonic pain in healthy volunteers [192]. The effect of local and spinal TENS combined with the SWC for PI produced a significant improvement in size, healing, skin temperature, and pain levels in older adults with chronic PIs and cognitive impairment [203]. Treatment with TENS is effective for reducing pain in people with fibromyalgia. In addition, the inclusion of TENS in therapeutic exercise programs seems to have a greater effect than practicing therapeutic exercise in isolation [204]. TENS may serve as an effective and well-tolerated alternative for migraineurs. However, low quality of evidence demands further research [205]. TENS was not superior to fentanyl for pain relief in laparoscopic surgery with patients who underwent gynecologic laparoscopy under spinal anesthesia [206]. It can provide additional reduction in chronic post-stroke spasticity, mainly as additional therapy to physical interventions. Studies with better methodological quality and larger sample are needed to increase evidence power [207]. TENS was effective in reducing pain intensity during carboxytherapy in patients with cellulite in the gluteal region [208]. FS-TENS is an effective option for treating multisite chronic pain in a real-world setting. The most significant impact was a clinically meaningful reduction in pain interference with activity and mood. There were also statistically significant reductions in pain intensity and pain interference with sleep. Pain intensity and pain interference with activity and mood exhibited a dose–response association [209]. TENS may be effective for long-distance walking in patients with pre-radiographic knee osteoarthritis [210] (Figure 18,Table 10).

Spinal Manipulation Primary Therapy (Chiropractic Care)

Chiropractors use hands-on spinal manipulation and other alternative treatments, the theory being that proper alignment of the body's musculoskeletal structure, particularly the spine, will enable the body to heal itself without surgery or medication [211-213]. While the mainstay of chiropractic is spinal manipulation, chiropractic care may also include other treatments, including manual or manipulative therapies, postural and exercise education, and ergonomic training (how to walk, sit, and stand to limit back strain). Chiropractors today often work in conjunction with primary care doctors, pain experts, and surgeons to treat patients with pain [214-216]. Chiropractors use 4 broad categories of therapeutic interventions:

a) Joint manipulation and mobilization

b) Soft tissue manipulation and massage

c) Exercise and physical rehabilitation prescription

d) Home care and activity modification advice.

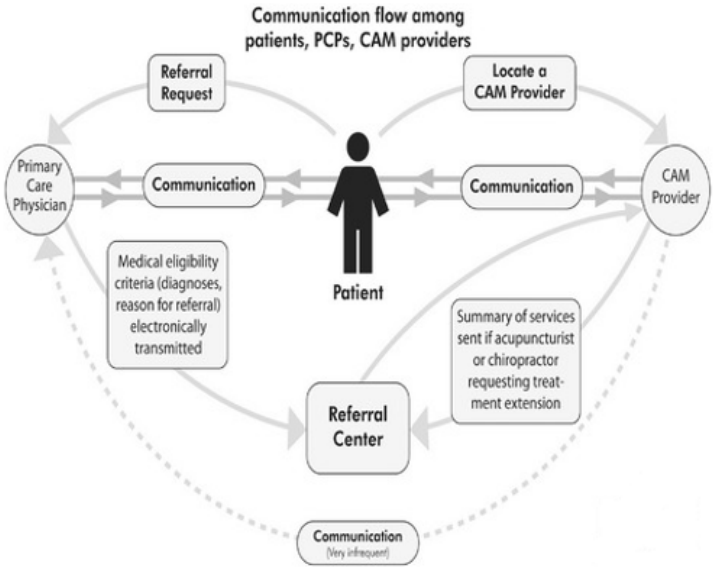

Figure 19: Communication flow among patients, PCPs, CAM providers. This illustrates the complex flow of communications among patients with chronic musculoskeletal pain, primary care providers (PCPs), and complementary and alternative medicine (CAM) providers within and outside of a managed care system. The CAM providers are acupuncturists and chiropractors. Although progress is being made, poor integration of care remains a challenge across the US health care system. As more insurers offer alternative treatment benefits and as more physicians support the use of CAM treatments for pain management, additional potential coordination difficulties arise. Patients, PCPs, and A/C providers desire more communication; thus, systems need to be created to facilitate more open communication which could positively benefit patient outcomes. Collaborative care provides patients with therapeutic options within an environment where health care providers and patients are informed (Penney LS, Ritenbaugh C, Elder C, Schneider J, Deyo RA, DeBar LL. Primary care physicians, acupuncture and chiropractic clinicians, and chronic pain patients: a qualitative analysis of communication and care coordination patterns. BMC Complement Altern Med. 2016; 16:30. Published 2016 Jan 25. doi:10.1186/s12906-016-1005-4).

In addition, nutritional and dietary counseling, physical therapy modalities (e.g., heat, ice, ultrasound, electro-modalities), and taping/bracing are also used as adjunct procedures [217]. Survey by Swedish Agency for Health Technology Assessment and Assessment of Social Services, SBU shows 69% of the physiotherapists stated that they frequently used 'circulation training' as compared to 36% of chiropractors and 13% of the physiotherapists regularly used spinal manipulation whereas the corresponding figure for chiropractors was 96% [218]. Chiropractors are frequent providers of care for patients with lower back pain. Practitioner attitudes and beliefs have been shown to be associated with clinical outcomes for patients with low back pain [219]. Many individuals with LBP have never been to a chiropractor and may not be open to trying it for the first time for a variety of reasons, including negative public perceptions about chiropractic. Many have likely heard about the possibility that chiropractic care may cause serious harms, including vertebral artery dissection (VAD) leading to stroke, paralysis, or death. However, few are likely aware that VAD itself may result in neck pain, prompting individuals to seek care, whether from chiropractors, PCPs, or other providers [220]. Spinal Manipulation imparts some benefit in back pain without any adverse events [221]. For adolescents with chronic LBP, spinal manipulation combined with exercise was more effective than exercise alone over a 1-year period, with the largest differences occurring at 6 months. These findings warrant replication and evaluation of cost effectiveness [222]. Chiropractic was superior to sham chiropractic and physiotherapy treatments, but it was less effective than pharmaceutical treatment and other therapies [223]. SMT could not lead to significantly different outcomes (clinical and biomechanical) in participants with CTP than a control condition only including the evaluation of spinal stiffness [224]. Chiropractic was one of the leading alternatives to standard medical treatment in cancer pain management [225,226]. The effectiveness of chiropractic was equivalent to these conventional treatments in the management of neck pain [227]. Chiropractic demonstrated no significant difference with any other treatment mode in fibromyalgia [228]. CTTH is common, contributing to significant loss of work and high socioeconomic costs. Chiropractors have capacity to offer an additive approach to patient care in FHT setting within collaborative care models [229] (Figure 19).

Acupuncture

Table 11: Conditions that may be amenable to acupuncture identified by the WHO [231].

Upper respiratory tract disorders	Acute sinusitis; Acute rhinitis; Acute tonsillitis
Gastrointestinal disorders	Acute/chronic gastritis; Chronic duodenal ulcer (pain); Chronic colitis; Pelvic pain
Neurological disorders	Headache; Migraine; Trigeminal neuralgia; Post-herpetic neuralgia; Peripheral neuropathies; Intercostal neuralgia
Musculo-skeletal disorders	Tennis elbow; Frozen shoulder; Cervico-brachial syndrome; Sciatica; Low back pain; Osteoarthritis; Phantom limb pain; Fibromyalgia
Other	Dysmenorrhea; Atypical chest pain; Labor pain/stimulation of labor; Dental pain

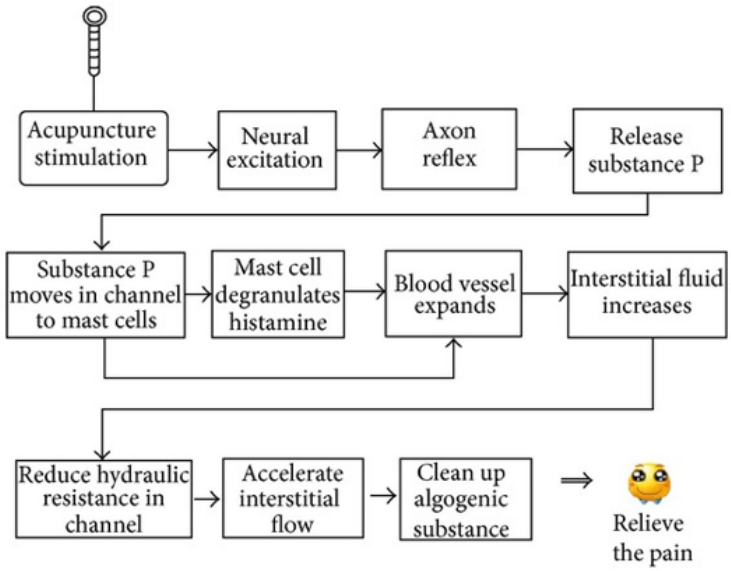

Figure 20: A mechanism of action of acupuncture in treating chronic pain. The exact mechanism of how acupuncture decreases HR in the meridian channels requires further study in order to be answered. Two mechanisms are involved in the change. One is the pathway related to the blood vessel system. When a needle is inserted into an acupoint, the nerve terminal which usually consists of Aδ or C fibers is excited and sends a neural pulse signal to the central nerve system. Then, an axon reflex develops which leads to the release of substance P (SP) and other chemicals into the interstitial fluid around the needle. SP and other signals diffuse and migrate to mast cells nearby through interstitial flow along meridian channels. Mast cells then degranulate and release histamine which will continue to move along meridian channels. SP and histamine can make surrounding blood vessels expand and become more permeable allowing more interstitial fluid to flow outside the vessel. This accelerates the flow along meridian channels and reduces the hydraulic resistance along the channels. The lower resistance further facilitates the interstitial flow which can eliminate algogenic substances to relieve pain (Source: Zhang WB, Xu YH, Tian YY, et al. Induction of Hyperalgesia in Pigs through Blocking Low Hydraulic Resistance Channels and Reduction of the Resistance through Acupuncture: A Mechanism of Action of Acupuncture. Evid Based Complement Alternat Med. 2013; 2013:654645).

Acupuncture is a traditional Chinese practice of medicine that has gained popularity in Western culture and around the world. It involves the insertion of thin needles into the skin to stimulate nerves, muscles, and connective tissues throughout the body with the goal of alleviating pain, tension, and stress. More broadly, acupuncture is actually a family of different procedures. There are associated risks; however, serious side effects are rare [230]. The Standard Acupuncture Nomenclature published by the WHO listed about 400 acupuncture points and 20 meridians connecting most of the points [231]. Acupuncture treatment and control group interventions in parallel-group randomized trials of acupuncture are not always precisely reported. In an attempt to improve standards, an international group of experienced acupuncturists and researchers devised a set of recommendations, designating them STRICTA. The intended outcome is that interventions in controlled trials of acupuncture will be more adequately reported, thereby facilitating an improvement in critical appraisal, analysis and replication of trials [232]. Although acupuncture is widely used to manage chronic pain, it remains highly controversial, largely due to the lack of a clear mechanism [233]. American College of Physicians' guidelines recommend acupuncture as one of several options, such as manual therapy or exercise, for patients with back pain [234]. UK NICE guidelines recommend acupuncture for chronic headache or migraine [235]. The adverse effects of acupuncture are short-lasting and mild, such as tiredness and drowsiness, making acupuncture potentially a safer choice of treatment for improving QoL of chronic PAWS patients [236]. There have been recommendations against using acupuncture for osteoarthritis in several guidelines including those from NICE [237] and the American Academy of Orthopedic Surgeons (AAOS) [238]. Compared with conventional drug therapy acupuncture alone did not show superior effects on pain relief. But along with drug therapy, resulted in increased remission rate of pain, shorter onset time of pain relief, longer duration of analgesia time, and better quality of life without serious adverse effects, as compared with drug therapy alone [14]. Acupuncture is effective for the treatment of chronic pain and is therefore a reasonable referral option [239]. Differences between true and sham acupuncture are smaller than those between true acupuncture and no acupuncture control [239,233]. No current guidelines recommend acupuncture for neck or shoulder pain [233]. Acupuncture is effective for the treatment of chronic musculoskeletal, headache, and osteoarthritis pain [240]. No systematic review has evaluated the effectiveness of acupuncture for combined neck pain, back pain, and lower back pain [3]. It is a safe and well-tolerated treatment option, improving a broader proportion of patients than current pharmaceutical options for women with fibromyalgia [241], however, for pain relief and reducing the number of tender points, acupuncture proved superior to drugs [242]. Acupuncture may depress pain by activating a number of neurotransmitters or modulators such as opioid peptides, norephinephrine, serotonin, and adenosine. Acupuncture may also activate the endogenous pain inhibitory pathway. Certain modes of acupuncture improved postoperative pain on the first day after surgery and reduced opioid use [243,244] (Table 11,Figure 20).

Physiotherapy

Early physical therapy appears to be associated with subsequent reductions in longer-term opioid use and lower-intensity opioid use for all of the musculoskeletal pain regions examined [7]. Physical therapy or physiotherapy is a branch of rehabilitative medicine aimed at helping patients maintain, recover or improve their physical abilities. PTs practice in many settings, such as private-owned physical therapy clinics, outpatient clinics or offices, health and wellness clinics, rehabilitation hospitals facilities, skilled nursing facilities, extend-

ed care facilities, private homes, education and research centers, schools, hospices, industrial and this workplaces or other occupational environments, fitness centers and sports training facilities [245]. Both OT) and PT services are provided to clients/patients of all age groups, infants through older adults, from a variety of socioeconomic, cultural, and ethnic backgrounds, who possess or who are at risk for impairments, activity limitations, or participation restrictions. Both professions recognize that health and well-being are supported when individuals are able to engage in activities that promote quality of life through a healthy lifestyle [246]. The focus of physical therapist is differential evaluation and the treatment of dysfunction rather than differential diagnosis and treatment of disease as in the case of physician [247]. Globally, physical therapy professional organizations have called for physical therapists to perform lifestyle behavior management during customary care, or health-focused care, due to increasing morbidity and mortality related to noncommunicable diseases. Given the potential for health-focused care to improve health outcomes, physical therapists should integrate health promotion into their daily clinical practice [248]. Physical therapists follow the Guide to Physical Therapist Practice, APTA, and state-directed practice laws in their quest to provide best care for patients. Physical therapists are also team members in a delivery model for patients with rheumatic diseases and musculoskeletal conditions. Other team members may include rheumatologists, orthopedic surgeons, nurses, occupational therapists, social workers, pharmacists, and psychologists just to name a few [249] (Figure 21).

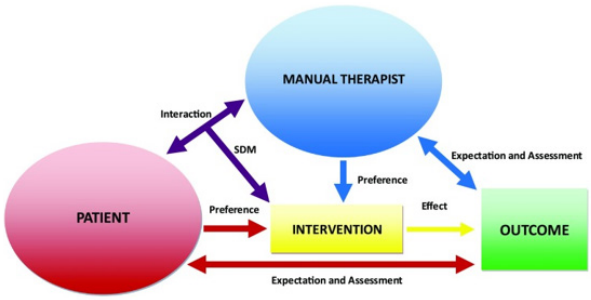

Figure 21: A comprehensive approach to manual physical therapy effectiveness accounting for interactions between patient, therapist, and intervention factors. Examples of factors include preferences, expectations, outcome assessment, and shared decision-making (SDM). Additionally, this view acknowledges the interaction between patient and manual physical therapist, which may yield important outcome contributions, either directly (i.e. intervention selection) or indirectly (i.e. modified expectations or mood). Finally, this approach acknowledges the integration of targeted adjunct interventions such as psychosocial strategies and exercise that may (1) enhance the effectiveness of manual therapy for reducing the impact of pain, and/or (2) promote and maintain positive behavioral change (Source: Coronado RA, Bialosky JE. Manual physical therapy for chronic pain: the complex whole is greater than the sum of its parts. J Man Manip Ther. 2017;25(3):115-117).

Figure 22: The Armeo system is for arm and hand therapy (Physiotherapy). An exoskeleton supports the movements, while for motivation different videogames can be played. The modular "Armeo" system was specifically designed for patients, whose hand and arm function has been affected due to a neurological disorder. The robotic system includes an arm exoskeleton and software that not only provides treatment plans and documentation options but also a variety of different games. For example, patients are asked to collect coins in an underwater setting or grab specific products in a supermarket. Depending on the exercise, this trains range of motion and coordination, strength or stamina. Patients continuously and immediately receive performance feedback. Treatment progress is being recorded and measured at the same time, allowing for better assessment of the course of treatment thanks to this data. In doing so, patients always perform the appropriate and individually adapted training. (Source: Wart O. Exoskeletons, Serious Games and Co.: New Technologies in Rehabilitation. Medica Magazine 06/01/2017).

Intervention such as mirror visual feedback with a 3D augmented reality system may augment manual therapy approaches by desensitizing the person and allowing a window for inclusion of complimentary treatment strategies [250]. PT intervention appears to be an effective, cost-effective, non-pharmacological method to decrease chronic pain in PLHIV [251]. PT should strongly be considered for the management of chronic pain to gradually increase flexibility and strength, for example in knee osteoarthritis where there is demonstrated benefit [252]. Risks of PT include myocardial infarction leading to sudden death, as well as worsening pain (especially at beginning of treatment) [1]. Patients with poor experience from physical therapy ignored the prescription since they could not see the difference between PAP and physiotherapy [253]. Survivors of major burn injury are subjected to painful physical therapy and occupational therapy that are essential for successful treatment and rehabilitation of their burns. The magnitude of the analgesic effect is clinically meaningful and is maintained with repeated use [254]. PT for primary idiopathic frozen shoulder can be useful for prescribing home exercises to increase shoulder mobility. Many physical therapies and home exercises can be used as a first-line treatment for adhesive capsulitis. PT has been shown to bring about pain relief and return of functional motion in patients with frozen shoulder [255]. An interdisciplinary

management involving human embryonic stem cell (hESC) therapy along with physiotherapy as a supportive therapy offers regenerative treatment of the patients with SCI [256]. Poor adherence to physiotherapy can negatively affect outcomes and healthcare cost [257]. Taylor et al. showed the ability of the physical therapist to manage effectively and safely simple peripheral musculoskeletal injuries in the emergency department significantly reducing the length of stay, waiting and treatment time of patients [258]. An individual PT and rehabilitation program may augment improvements in patient-reported outcomes following arthroscopy for FAI syndrome, reported by FAIR trial [259]. Patients with moderate knee OA with different grades of pain can benefit from a physiotherapy rehabilitation program, which was shown to be highly effective in patients with moderate pain, although this effect might be reduced in patients with severe pain [260]. Upper limb rehabilitation technology (Armeo Spring as training tool) could hold promise for complementing traditional MS therapy. Significant gains were found in functional capacity tests. After training completion, TEMPA scores improved [261] (Figure 22).

Yoga

The word "yoga" literally means "yoking", or "joining together" for a harmonious relationship between body, mind and emotions to unite individual human spirit with divine spirit or the True Self [262]. Yoga is a vast system of practices and philosophy that originate in India. Yoga can be helpful in pain management with both physical and mental benefits, but yoga is not a quick fix solution. Yoga has many of the same benefits as mindfulness practice, due to the common focus on breath, body and present moment awareness [263]. Yoga is very helpful in treating some of the mechanical aspects of pain, for example when there are tight muscles which contribute to pain. However, practiced incorrectly or without proper supervision yoga can also exacerbate your pain in the short term, despite the fact that research shows yoga is as safe as usual care and exercise [264,265]. Despite a number of reports and reviews supporting efficacy of yoga in health care, the awareness and integration of yoga in conventional healthcare remain limited [266] (Figure 23).

Figure 23: TYoga for pain relief. Yoga can help people with arthritis, fibromyalgia, migraine, low back pain, and many other types of chronic pain conditions. A study published in Annals of Internal Medicine found that among 313 people with chronic low back pain, a weekly yoga class increased mobility more than standard medical care for the condition. Another study published at nearly the same time found that yoga was comparable to standard exercise therapy in relieving chronic low back pain. A meta-analysis of 17 studies that included more than 1,600 participants concluded that yoga can improve daily function among people with fibromyalgia osteoporosis-related curvature of the spine. Practicing yoga also improved mood and psychosocial well-being (Yoga for pain relief. Web Harvard Health Publishing, April 2015)

Recent controlled studies of yoga for managing pain have been based on Hatha or Iyengar yoga. Studies that have used Hatha yoga have concentrated on relaxation techniques and gentle postures tailored to specific patient populations [267]. Integrating ancient wisdom of yoga and spirituality in the conventional palliative care setting appears to be a promising, cost-effective, and time-honored holistic approach offering a comprehensive wellness plan for patients [268].

Meditation and pranayama, along with relaxing asanas, can help individuals deal with the emotional aspects of chronic pain, reduce anxiety and depression effectively and improve the quality of life perceived [269]. There is a need for additional high-quality research to improve confidence in estimates of effect, to evaluate long-term outcomes, and to provide additional information on comparisons between yoga and other exercise for chronic non-specific low back pain [270]. Both yoga therapy and conventional exercise therapy, with 6 months follow up resulted in significant benefits in CLBP, with the yoga intervention having the greater impact [262]. Beneficial effects of yoga could be associated with elevated serum BDNF levels and maintained serotonin levels. Lee et al. investigated the effect of yoga on pain, BDNF, and serotonin in premenopausal women with chronic low back pain. The yoga group had decreased pain, increased BDNF and unchanged serotonin [271]. Yoga is an acceptable and safe intervention, which may result in clinically relevant improvements in pain and functional outcomes associated with a range of MSCs [272]. Yoga intervention may reduce pain and catastrophizing, increase acceptance and mindfulness, and alter total cortisol levels in women with FM [273]. An 8-week Yoga of Awareness intervention may be effective for improving symptoms, functional deficits, and coping abilities in FM [274]. Yoga of Awareness" (YoA) is a mind/body program that, along with physical exercises, includes mindful meditation and other coping tools drawn from the yoga tradition. Thus, it provides FM patients with both exercise and coping skills components of nonpharmacological therapy [267]. Headache frequency and intensity were reduced more in Yoga with conventional care than the conventional care group alone. Furthermore, Yoga therapy enhanced the vagal tone and decreased the sympathetic drive, hence improving the cardiac autonomic balance [275]. In a randomized controlled trial 72 migraine without aura patients were randomly assigned yoga therapy or self-care. A significant reduction in migraine frequency was reported in the yoga versus self-care group [276]. 8 weeks of Hata yoga exercises on women with knee osteoarthritis found to be effective and it could be used as a conservative treatment besides usual treatments and medications to improve the condition of people with osteoarthritis [277]. Approximately 41.1% of males and 56.5% of females suffer from OA. Over 40% of adults between 50 and 75 years are affected with knee OA worldwide. handgrip strength is positively related to normal bone mineral density in postmenopausal women and can be used as a screening tool for women at risk of osteoporosis [278]. In a yoga group received IAYT intervention for 1 week at yoga center, right and left

handgrip strength showed improvement after 1-week IAYT intervention [279]. The practice of yoga effects on knee OA reported positive outcomes on symptoms including pain, flexibility, functional disability, anxiety, and quality of life [280]. IAYT practice showed an improvement in TUG, STS, HGS, and Goniometer test, which suggest improved muscular strength, flexibility, and functional mobility [279]. Regular yoga training is helpful in reducing knee arthritic symptoms, promoting physical function, and general wellbeing in arthritic patients [281]. Yoga has been used clinically as a therapeutic intervention for improving strength, posture, balance, and flexibility in older adults [282]. Neuroinflammation is a complex process involving both the peripheral circulation and the CNS and is considered to underlie many CNS disorders including depression, anxiety, schizophrenia, and pain. Regular practice of yoga reduces inflammatory cytokines in general and might protect the individual from inflammatory diseases (significantly reduce levels of TNF-α and IL-6). This study is particularly important because it examined how yoga influences the body's response to a stressor, in this case exercise, and found that it effectively dampened the pro-inflammatory response [283]. Raj-yoga meditation and pranayama in combination with conventional, noninvasive, treatment modalities showed promising results in MPDS patients as compared to either modalities alone [284]. In a cohort of women with chronic pelvic pain, an 8-week yoga intervention resulted in improvement in pain and quality of life scores compared to the control group that was treated with non-steroidal anti-inflammatory drugs [285]. Despite a wide range of methodological gaps and limitations, yoga interventions were shown to be beneficial and yielded positive results without any adverse outcomes. It is also recommended that cancer caregivers are trained and certified as the "yoga therapists" who have knowledge of the particular disease and understand the needs of the patients [286]. The variety of benefits derived, the absence of side effects, and the cost-benefit ratio of therapeutic yoga make it an interesting alternative for family physicians to suggest to their patients with cancer [287]. Cancer patients in conventional treatment usually receive one or more of radiotherapy, chemotherapy, surgical intervention and hormone therapy. The patients using yoga as a complementary therapy in adult cancer reported positive benefits in terms of physical, psychological and social wellbeing. The most commonly reported direct benefit of yoga was its breath-related awareness of mind and body. Patients reported affinity for yoga as a complementary therapy, but felt one or more concerns of transportation, scheduling, lack of time and cost were significant barriers to yoga adherence [288]. Yoga uses the model of five-dimensional perceptions. The human being is considered to experience every interaction through the physical, vital, emotional, intellectual and spiritual perceptions simultaneously, with the physical sheath being the grossest and others progressively subtler; and the intellectual and spiritual perceptions being the subtlest [289-311]. It also states that the ripples in the emotional sheath affect the grosser dimensions of vital energy flow and physical body [269,312-321] (Figure 24).

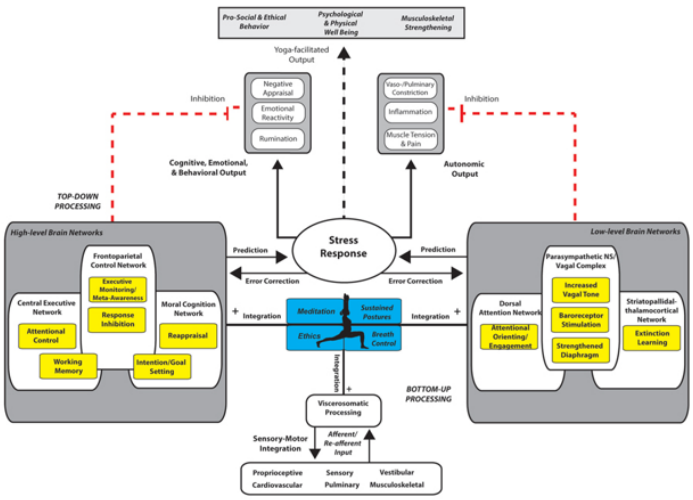

Figure 24: Systems network model of yoga for optimizing self-regulation. The major limbs of yoga are represented in blue boxes as a skillset of four process tools: ethics, meditation, breath regulation, and postures. Application of these skills (limbs of yoga) across cognitive, emotional, behavioral, and autonomic domains in the context of physical and emotional stress is proposed to generalize to similar challenges off the yoga mat and in everyday life. Together, these tools of yoga improve the efficiency, bidirectional feedback, and integration (+ black lines) between high- and low-level brain networks, and afferent and re-afferent input from interoceptive processes (e.g., multi-sensory, proprioceptive, vestibular, cardiovascular, pulmonary, musculoskeletal) in the context of stress. Through an emphasis on interoception and bottom-up input, integration facilitates inhibition (red lines) of maladaptive forms of cognitive, emotional, and behavioral output as well as autonomic output associated with stress. Efficiency improves the communication and flexibility between brain and bodily systems to inform behavioral output. Yoga's four tools are described to involve particular regulatory processes associated with each set of brain networks (indicated in yellow boxes). With mastery of practice, regulatory processes become more automatized, requiring less effort to initiate when necessary and terminate more rapidly when no longer needed. A central executive network supports top-down mechanisms of attentional control and working memory allowing monitoring for proper goal-directed behavior followed by self-correction if needed. A FPCN supports executive monitoring, meta-awareness, reappraisal, and response inhibition mechanisms. A moral cognition network supports motivation and intention setting associated with self-care and prosocial behavior. The dorsal attention network helps to support attentional orienting, and engagement. Hypothlamic–pituitary–adrenal (HPA) axis communication with brainstem vagal efferents support parasympathetic control and homeostasis across systems. A striatopallidal–thalamocortical network is responsible for facilitating extinction learning and reconsolidation of maladaptive habits into behavior that is aligned with intentions and outcomes into adaptive habits. Dotted lines represent new, adaptive pathways for responding to stress. A focus toward bottom-up processes facilitates a shift toward perceptual inference rather than active inference, and improves prediction and error correction processes, thus supporting optimal self-regulation (Source: Gard T, Noggle JJ, Park CL, Vago DR, Wilson A. Potential self-regulatory mechanisms of yoga for psychological health. Front Hum Neurosci. 2014; 8:770. Published 2014 Sep 30. doi:10.3389/fnhum.2014.00770).

Conclusion

Pain is complex, so is their measures. There are many treatment options -- medications, therapies, and mind-body techniques. Acute pain can last a moment; rarely does it become chronic pain. Chronic pain persists for long periods. It is often resistant to most medical treatments and cause severe problems. Again, modern medical system suggests CAM and pharmacotherapy together, instead of long-term use of pain killers alone. Lifestyle modification is another important thing to improve situation and sustain the benefits of therapy. Pain may be located in one part of the body or it may be widespread. Studies suggest that a person's outlook and the way they cope emotionally with long-term (chronic) pain can influence their quality of life. The occurrence of pain rises as people get older, and women are more likely to experience pain than men. The vulnerable population should be kept in touch with physicians for pain management and be aware of mediators that may impart a further worsening situation. Physical therapy focuses on exercises and stretches that help make the body stronger and more able to function and move. Once the problem has been identified, a physical therapy session could include strengthening exercises, low impact aerobics, and pain relief stretches. Our minds can affect how we perceive and experience pain. Stress and anxiety can even make chronic pain worse. Therefore, body-mind therapies are useful for helping patients better cope with the pain and stress. Body-mind therapy works by teaching patients how to manage their emotions, thoughts, stress, and the body's physical responses. There is ample evidence that stress and anxiety push the level of chronic pain. Serotonin and dopamine are two key neurotransmitters that affect our mood. Unbalanced levels of these two neurotransmitters are linked to anxiety and depression disorders. Healthful living, smiling, watching movies, pleasure trips, gossiping, playing VDO games keeps us busy and reduce stress related decay. When it comes to managing pain, Buddha's well-known words written many centuries ago still ring true: How you think about your pain can change how you feel it, for better or worse. Neuroscientific studies have shown that our brains physically change when we experience positive or negative emotions. This plays a significant role in how well we manage pain, especially on a day-to-day basis. The mind and body are in constant communication, so the way we perceive our pain can change the way we feel it. This is why shifting our perspectives about our pain is so important—it's an effective way to control our symptoms, no drugs required.

Summary

The vast majority are eager to do pretty much anything to get away from the grasps of interminable agony. One of the primary cures offered to endless torment sufferers is prescription medications. Prescription painkillers are compelling much of the time. Be that as it may, the relief from discomfort they offer includes some major disadvantages for some. Painkillers risk getting to be addictive. What's more, as endless news reports have appeared, the consequences of dependence on painkillers can be wrecking. Non-tranquilize therapies decline torment and can be utilized notwithstanding pharmaceuticals or in lieu of pharmaceuticals. They offer the likelihood to enhance your personal satisfaction. Similarly, as with some other treatment, every individual will react distinctively to various therapies, and there is no certification that any treatment will give total help with discomfort. Though many evidences were weaker, the researchers also found that massage therapy, spinal manipulation, and osteopathic manipulation may provide some help for back pain, fibromyalgia, osteoarthritis, cancer pain, knee replacement, migraine, frozen shoulder and chronic non-migraine headache. These data can equip providers and patients with the information they need to have informed conversations regarding non-drug approaches for treatment of specific pain conditions. It's important that continued research explore how these approaches actually work and whether these findings apply broadly in diverse clinical settings and patient populations.

Compliance with the Ethical Issues

Ethics approval and consent to participate

Animal and Human experiment: N/A

Human Data Submission Approval: N/A

Consent for publication

Consent to publish Individual Person's data: N/A

Availability of data and materials

Data sharing: Data will be provided upon request.

Competing interests

The author declares that he has no competing interest

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References

1. Tompkins DA, Hobelmann JG, Compton P (2017) Providing chronic pain management in the "Fifth Vital Sign" Era: Historical and treatment perspectives on a modern-day medical dilemma. Drug Alcohol Depend 173(Suppl 1): S11-S21.

2. Hadjiat Y, Serrie A, Treves R, Chomier B, Geranton L, et al. (2018) Pain associated with health and economic burden in France: results from recent National Health and Wellness Survey data. Clinicoecon Outcomes Res 10: 53-65.

3. Xu T, Zhou S, Zhang Y, Yu Y, Li X, et al. (2019) Acupuncture for chronic uncomplicated musculoskeletal pain associated with the spine: A systematic review protocol. Medicine (Baltimore) 98(2): e14055.

4. Guertin JR, Pagé MG, Tarride JÉ, Talbot D, Watt-Watson J, et al. (2018) Just how much does it cost? A cost study of chronic pain following cardiac surgery. J Pain Res 11: 2741-2759.

5. CMS: US health care spending to reach nearly 20% of GDP by 2025. Web Advisory Board February 16, 2017.

6. NHE Fact Sheet. Web U.S. Centers for Medicare & Medicaid Services (CMS).

7. Sun E, Moshfegh J, Rishel CA, Cook CE, Goode AP, et al. (2018) Association of Early Physical Therapy With Long-term Opioid Use Among Opioid-Naive Patients With Musculoskeletal Pain. JAMA Netw Open 1(8): e185909.

8. Geurts JW, Willems PC, Kallewaard JW, van Kleef M, Dirksen C (2018) The Impact of Chronic Discogenic Low Back Pain: Costs and Patients' Burden. Pain Res Manag 2018: 4696180.

9. Yue peng L, Xue C, Shi chen L, Shi hua Z, Yu hang Z (2018) Neuromuscular electrical stimulation for treating postpartum low back pain. Medicine 97(28): e11426.

10. Katonis P, Kampouroglou A, Aggelopoulos A, K Kakavelakis, S Lykoudis, et al. (2011) Pregnancy-related low back pain. Hippokratia 15(3): 205-210.

11. Sabino J, Grauer JN (2008) Pregnancy and low back pain. Curr Rev Musculoskelet Med 1(2): 137-141.

12. Zeb A, Arsh A, Bahadur S, Ilyas SM (2018) Effectiveness of transcutaneous electrical nerve stimulation in management of neuropathic pain in patients with post traumatic incomplete spinal cord injuries. Pak J Med Sci 34(5): 1177-1180.

13. Li Z, Aninditha T, Griene B, Javier Francis, Paulo Renato, et al. (2018) Burden of cancer pain in developing countries: a narrative literature review. Clinicoecon Outcomes Res 10: 675-691.

14. Hu C, Zhang H, Wu W, Weiqing Yu, Yong Li, et al. (2016) Acupuncture for Pain Management in Cancer: A Systematic Review and Meta-Analysis. Evid Based Complement Alternat Med 2016: 1720239.

15. Bi XL, Xie CX (2018) Effect of neuromuscular electrical stimulation for endometriosis-associated pain: A retrospective study. Medicine (Baltimore) 97(26): e11266.

16. Nersesyan H, Slavin KV (2007) Current approach to cancer pain management: Availability and implications of different treatment options. Ther Clin Risk Manag 3(3): 381-400.

17. Gan TJ (2017) Poorly controlled postoperative pain: prevalence, consequences, and prevention. J Pain Res 10: 2287-2298.

18. Tantawy SA, Kamel DM, Abdelbasset WK (2017) Does transcutaneous electrical nerve stimulation reduce pain and improve quality of life in patients with idiopathic chronic orchialgia? A randomized controlled trial. J Pain Res 11: 77-82.

19. Tao H, Wang T, Dong X, Guo Q, Xu H, et al. (2018) Effectiveness of transcutaneous electrical nerve stimulation for the treatment of migraine: a meta-analysis of randomized controlled trials. J Headache Pain 19(1): 42.

20. Burch R, Rizzoli P, Loder E (2018) The Prevalence and Impact of Migraine and Severe Headache in the United States: Figures and Trends From Government Health Studies. Headache 58(4): 496-505.

21. Bonafede M, Sapra S, Shah N, Tepper S, Cappell K, et al. (2018) Direct and indirect healthcare resource utilization and costs among migraine patients in the United States. Headache 58(5): 700-714.

22. Jeevanantham D, Rajendran V, Tremblay L, Larivière C, Knight A (2018) Evidence-based guidelines for physiotherapy management of patients with multiple myeloma: study protocol. Syst Rev 7(1): 118.

23. Web geriatric pain. (2006) Nondrug Pain and Symptom Management Overview. Swedish Medical Center. Nursing Assistant End -of-Life: Computerized Educational Program. Pittsburgh, PA: Hospice and Palliative Nursing Association.

24. Delaune SC, Ladner PK (2002) Fundamental of Nursing: Standard and Practice (2nd edn), New York, pp.916-941.

25. Yurdanur Demir (2012) Non-Pharmacological Therapies in Pain Management. Pain Management - Current Issues and Opinions. Dr Gabor Racz (Ed).

26. Geziry AE, Toble Y, Kadhi FA, Pervaiz M, Nobani MA (2018) Non-Pharmacological Pain Management. Nabil A Shallik (Ed). Web Intech Open.

27. Campbell B Non-Drug Treatments for Pain: Nine Strategies.

28. Web learn.org. Art Therapy Certification and Training Programs.

29. Rodriguez D (2013) Pain Management Without Drugs. Medically Reviewed by Pat F Bass III. Web Everyday Health

30. WebMD 11 Tips for Living with Chronic Pain.

31. Tick H, Nielsen A, Pelletier KR, Bonakdar R, Simmons S, et al. (2018) Pain Task Force of the Academic Consortium for Integrative Medicine and Health. Evidence-Based Nonpharmacologic Strategies for Comprehensive Pain Care: The Consortium Pain Task Force White Paper. Explore (NY) 14(3): 177-211.

32. Power Recent advances in postoperative pain therapy. (2005) BJA 95(1): 43-51.

33. Stanford Healthcare web. Management of Pain without Medications.

34. Care Notes. (2018) Non-pharmacological Pain Management Therapies for Adults (Medically Reviewed). Web drugs.com

35. Nadler SF. (2004) Nonpharmacologic Management of Pain. The Journal of the American Osteopathic Association 104: 6S-12S.

36. Winerman L (2018) The rise of non-drug pain treatment. Sub-title: As the United States fights an opioid crisis, psychologists are in demand for nonpharmacological treatment options for chronic pain—though hurdles remain. American Psychological Association 49(10): 45.

37. Web Care Search Australia. Non-Pharmacological Approaches.

38. Black R. (2017) The PPM Guide to Relieving Pain Without Medication. Web Practical pain Management.

39. McCaffery M (2002) What is the Role of Nondrug Methods in the Nursing Care of Patients with Acute Pain? Pain Management Nursing 3(3): 77-80.

40. Goertz CM, George SZ (2018) Insurer Coverage of Nonpharmacological Treatments for Low Back Pain—Time for a Change. JAMA Netw Open 1(6): e183037.

41. Dindo L, Zimmerman MB, Hadlandsmyth K, St Marie B, Embree J, et al. (2018) Acceptance and Commitment Therapy for Prevention of Chronic Postsurgical Pain and Opioid Use in At-Risk Veterans: A Pilot Randomized Controlled Study. J Pain 19(10): 1211-1221.

42. O'Connell C, Azad T, Mittal V, Vail D, Johnson, E, et al. (2018) Preoperative depression, lumbar fusion, and opioid use: an assessment of postoperative prescription, quality, and economic outcomes. Neurosurgical Focus FOC 44(1): E5.

43. Liu XY, Ma YK, Zhao JC, Wu ZP, Zhang L, et al. (2018) Risk Factors for Preoperative Anxiety and Depression in Patients Scheduled for Abdominal Aortic Aneurysm Repair. Chin Med J (Engl) 131(16): 1951-1957.

44. Roditi D, Robinson ME (2011) The Role of Psychological Interventions in the Management of Patients with Chronic Pain. Psychol Res Behav Manag 4: 41-49.

45. Thapa P, Euasobhon P (2018) Chronic postsurgical pain: current evidence for prevention and management. Korean J Pain 31(3): 155-173.

46. Nicholls JL, Azam MA, Burns LC, Katz J, Clarke Het al. (2018) Psychological treatments for the management of postsurgical pain: a systematic review of randomized controlled trials. Patient Relat Outcome Meas 9: 49-64.

47. Web Visiting Nurses Foundation. Comfort Therapy Program.

48. Web UnityPoint Health. Comfort Therapy with Hospice.

49. Web VITAS Healthcare. Complementary Therapies Increase Comfort, Well-Being of Hospice Patients.

50. Jamison RN, Virts KL (1990) The influence of family support on chronic pain. Behav Res Ther 28(4): 283-287.

51. Reinhard SC, Given B, Petlick NH, et al. (2008) Supporting Family Caregivers in Providing Care. In: Hughes RG, editor. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Rockville (MD): Agency for Healthcare Research and Quality, US.

52. Riffin C, Fried T, Pillemer K (2016) Impact of Pain on Family Members and Caregivers of Geriatric Patients. Clin Geriatr Med 32(4): 663-675.

53. Kabakian-Khasholian T, Portela A (2017) Companion of choice at birth: factors affecting implementation. BMC Pregnancy Childbirth 17(1): 265.

54. Vitoula K, Venneri A, Varrassi G Adewusi J, Zis P, et al. (2018) Behavioral Therapy Approaches for the Management of Low Back Pain: An Up-To-Date Systematic Review. Pain Ther 7(1): 1-12.

55. Gloth MJ, Matesi AM (2001) Physical therapy and exercise in pain management. Clin Geriatr Med 17(3): 525-535.

56. Mior S (2001) Exercise in the treatment of chronic pain. Clin J Pain 17(4): S77-S85.

57. Alami S, Desjeux D, Lefèvre Colau MM, et al. (2011) Management of pain induced by exercise and mobilization during physical therapy programs: views of patients and care providers. BMC Musculoskelet Disord 12: 172.

58. Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, et al. (2017) Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. Cochrane Database Syst Rev 14(4): CD011279.

59. Reis AD, Pereira PTVT, Diniz RR, et al. (2018) Effect of exercise on pain and functional capacity in breast cancer patients. Health Qual Life Outcomes 16(1): 58.

60. Susko AM, Fitzgerald GK (2013) The pain-relieving qualities of exercise in knee osteoarthritis. Open Access Rheumatol 5: 81-91.

61. Lane E, Latham T (2009) Managing pain using heat and cold therapy. Paediatr Nurs 21(6): 14-18.

62. Arankalle D, Wardle J, Nair PM (2016) Alternate hot and cold application in the management of heel pain: A pilot study. Foot (Edinb) 29: 25-28.

63. Dehghan M, Farahbod F (2014) The efficacy of thermotherapy and cryotherapy on pain relief in patients with acute low back pain, a clinical trial study. J Clin Diagn Res 8(9): LC01-LC04.

64. Saeki Y (2002) Effect of local application of cold or heat for relief of pricking pain. Nurs Health Sci 4(3): 97-105.

65. Kim EJ, Choi YD, Lim CY, Kim KH, Lee SD. Effect of heating and cooling combination therapy on patients with chronic low back pain: study protocol for a randomized controlled trial. Trials 16: 285.

66. Khalkhali H, Tanha ZE, Feizi A, Ardabili SS (2014) Effect of applying cold gel pack on the pain associated with deep breathing and coughing after open heart surgery. Iran J Nurs Midwifery Res 19(6): 545-549.

67. Chailler M, Ellis J, Stolarik A, Woodend K (2010) Cold therapy for the management of pain associated with deep breathing and coughing post-cardiac surgery. Can J Cardiovasc Nurs 20(2): 18-24.

68. Crawford C, Boyd C, Paat CF, et al. (2016) The Impact of Massage Therapy on Function in Pain Populations-A Systematic Review and Meta-Analysis of Randomized Controlled Trials: Part I, Patients Experiencing Pain in the General Population. Pain Med 17(7): 1353-1375.

69. Vickers A, Zollman C, Reinish JT (2001) Massage therapies. West J Med 175(3): 202–204.

70. Field T (2002) Massage therapy. Med Clin North Am 86(1): 163-171.

71. Moyer CA, Rounds J, Hannum JW (2004) A meta-analysis of massage therapy research. Psychol Bull 130(1): 3-18.

72. Field T (2016) Massage therapy research review. Complement Ther Clin Pract 24: 19-31.

73. Lakhan SE, Sheafer H, Tepper D (2016) The Effectiveness of Aromatherapy in Reducing Pain: A Systematic Review and Meta-Analysis. Pain Res Treat.

74. Navarra M, Mannucci C, Delbò M, Calapai G (2015) Citrus bergamia essential oil: from basic research to clinical application. Front Pharmacol 6: 36.

75. PDQ Integrative, Alternative, and Complementary Therapies Editorial Board. Aromatherapy with Essential Oils (PDQ®): Health Professional Version. 2019 Jan 8. In: PDQ Cancer Information Summaries. Bethesda (MD): National Cancer Institute (US).

76. Hekmatpou D, Pourandish Y, Farahani PV, Parvizrad R (2017) The Effect of Aromatherapy with the Essential Oil of Orange on Pain and Vital Signs of Patients with Fractured Limbs Admitted to the Emergency Ward: A Randomized Clinical Trial. Indian J Palliat Care 23(4): 431-436.

77. Gok Metin Z, Arikan Donmez A, Izgu N, Ozdemir L, Arslan IE (2017) Aromatherapy Massage for Neuropathic Pain and Quality of Life in Diabetic Patients. J Nurs Scholarsh 49(4): 379-388.

78. Morone NE, Greco CM, Weiner DK (2007) Mindfulness meditation for the treatment of chronic low back pain in older adults: a randomized controlled pilot study. Pain 134(3): 310-319.

79. Hilton L, Hempel S, Ewing BA, Apaydin E, Xenakis L, et al. (2016) Mindfulness Meditation for Chronic Pain: Systematic Review and Meta-analysis. Ann Behav Med 51(2): 199-213.

80. Patil SG (2009) Effectiveness of mindfulness meditation (Vipassana) in the management of chronic low back pain. Indian J Anaesth 53(2): 158-163.

81. Zeidan F, Vago DR (2016) Mindfulness meditation-based pain relief: a mechanistic account. Ann N Y Acad Sci 1373(1): 114-127.

82. Zeidan F, Grant JA, Brown CA, McHaffie JG, Coghill RC (2012) Mindfulness meditation-related pain relief: evidence for unique brain mechanisms in the regulation of pain. Neurosci Lett 520(2): 165-173.

83. Lutz A, Slagter HA, Dunne JD, Davidson RJ (2008) Attention regulation and monitoring in meditation. Trends in Cognitive Sciences 12(4): 163-169.

84. Austin JH (1998) Zen and the Brain: Toward an Understanding of Meditation and Consciousness. xxiv. MIT, Press, Cambridge, MA, pp. 844.

85. Holden R, Holden J (2013) Music: a better alternative than pain? Br J Gen Pract 63(615): 536.

86. Bradt J, Norris M, Shim M, Gracely EJ, Gerrity P (2016) Vocal Music Therapy for Chronic Pain Management in Inner-City African Americans: A Mixed Methods Feasibility Study. J Music Ther 53(2): 178-206.

87. Web Music Care. Training Context.

88. Hoareau SG, De Diego E, Guétin S (2015) Pain management and music therapy. Rev Infirm (217): 31-33.

89. Krishnaswamy P, Nair S (2016) Effect of Music Therapy on Pain and Anxiety Levels of Cancer Patients: A Pilot Study. Indian J Palliat Care 22(3): 307-311.

90. Guétin S, Giniès P, Siou DK, Picot MC, Pommié C, et al. (2012) The effects of music intervention in the management of chronic pain: a single-blind, randomized, controlled trial. Clin J Pain 28(4): 329-337.

91. Magill Levreault L (1993) Music therapy in pain and symptom management. J Palliat Care 9(4): 42-48.

92. Cepeda MS, Carr DB, Lau J, Alvarez H (2006) Music for pain relief. Cochrane Database Syst Rev (2): CD004843.

93. Singh P, Chaturvedi A (2015) Complementary and alternative medicine in cancer pain management: a systematic review. Indian J Palliat Care 21(1): 105-115.

94. Garza Villarreal EA, Pando V, Vuust P, Parsons C (2017) Music-Induced Analgesia in Chronic Pain Conditions: A Systematic Review and Meta-Analysis. Pain Physician 20(7): 597-610.

95. Chai PR, Carreiro S, Ranney ML, Karanam K, Ahtisaari M, et al. (2017) Music as an Adjunct to Opioid-Based Analgesia. J Med Toxicol 13(3): 249-254.

96. Uyar M, Akın Korhan E (2011) The effect of music therapy on pain and anxiety in intensive care patients. Agri 23(4): 139-146.

97. Alparslan GB, Babadağ B, Özkaraman A, Yıldız P, Musmul A, et al. (2016) Effects of music on pain in patients with fibromyalgia. Clin Rheumatol 35(5): 1317-1321.

98. Simon HB (2015) Music as Medicine. The American Journal of Medicine 128(2): 208-210.

99. Garza Villarreal EA, Wilson AD, Vase L, Brattico E, Barrios FA, et al. (2014) Music reduces pain and increases functional mobility in fibromyalgia. Front Psychol 5: 90.

100. Picard LM, Bartel LR, Gordon AS, Cepo D, Wu Q, et al. (2014) Music as a sleep aid in fibromyalgia. Pain Res Manag 19(2): 97-101.

101. McKenna P, Haste E (1999) Clinical effectiveness of dramatherapy in the recovery from neuro-trauma. Disabil Rehabil 21(4): 162-174.

102. Baker FA, Metcalf O, Varker T, O'Donnell M (2018) A systematic review of the efficacy of creative arts therapies in the treatment of adults with PTSD. Psychological Trauma 10(6): 643-651.

103. Stuckey HL, Nobel J (2010) The connection between art, healing, and public health: a review of current literature. Am J Public Health 100(2): 254-263.

104. Lumley M, Leisen J, Partridge R, Meyer TM, Radcliffe AM, et al. (2011) Does emotional disclosure about stress improve health in rheumatoid arthritis? Randomized, controlled trials of written and spoken disclosure. Pain 152(4): 866877.

105. Mugerwa S, Holden JD (2012) Writing therapy: a new tool for general practice?. Br J Gen Pract 62(605): 661-663.

106. Zhou C, Wu Y, An S, Li X (2015) Effect of Expressive Writing Intervention on Health Outcomes in Breast Cancer Patients: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. PLoS One 10(7): e0131802.

107. Lumley MA, Cohen JL, Borszcz GS, Cano A, Radcliffe AM, et al. (2011) Pain and emotion: a biopsychosocial review of recent research. J Clin Psychol 67(9): 942-968.

108. Kathryn Schaefer Ziemer, Amy Fuhrmann, MA & Mary Ann Hoffman (2015) Effectiveness of a Positive Writing Intervention for Chronic Pain: A Randomized Trial, MYOPAIN 23(3-4): 143-154.

109. Qian Lu, Matthew W Gallagher, Alice Loh, Lucy Young (2018) Expressive Writing Intervention Improves Quality of Life Among Chinese-American Breast Cancer Survivors: A Randomized Controlled Trial, Annals of Behavioral Medicine 52(11): 952–962.

110. Niles AN, Haltom KE, Mulvenna CM, Lieberman MD, Stanton AL, et al. (2013) Randomized controlled trial of expressive writing for psychological and physical health: the moderating role of emotional expressivity. Anxiety Stress Coping 27(1): 1-17.

111. Kupeli N, Schmidt UH, Campbell IC, Chilcot J, Roberts CJ, et al. (2018) The impact of an emotionally expressive writing intervention on eating pathology in female students. Health Psychol Behav Med 6(1): 162-179.

112. Yoon Frederiksen, Mia Skytte O'Toole, Mimi Y Mehlsen, Benedicte Hauge, Elbaek HO, et al. (2017) The effect of expressive writing intervention for infertile couples: a randomized controlled trial, Human Reproduction 32(2): 391–402.

113. Mackenzie CS, Wiprzycka UJ, Hasher L, Goldstein D (2007) Does expressive writing reduce stress and improve health for family caregivers of older adults? Gerontologist 47(3): 296-306.

114. Bernstein DN, Kelly M, Houck JR, Ketz JP, Flemister AS, et al. (2018) Oh I. PROMIS Pain Interference Is Superior vs Numeric Pain Rating Scale for Pain Assessment in Foot and Ankle Patients. Foot Ankle Int 40(2): 139-144.

115. Pain Assessment Screening Tool and Outcomes Registry (PASTOR) History and Methodologies. Clinical resources Web.

116. Diane M Flynn, Karon Cook, Michael Kallen, Chester Buckenmaier, Weickum R, et al. (2017) Use of the Pain Assessment Screening Tool and Outcomes Registry in an Army Interdisciplinary Pain Management Center, Lessons Learned and Future Implications of a 10-Month Beta Test. Military Medicine 182(1): 167–174.

117. Karon F Cook, Buckenmaier Chester, Richard C Gershon (2014) PASTOR/PROMIS® pain outcomes system: what does it mean to pain specialists? 4(4): 277-283

118. Flynn DM, Mc Quinn H, Fairchok A, Linda H Eaton, Snow T, et al. (2018) Enhancing the success of functional restoration using complementary and integrative therapies: Protocol and challenges of a comparative effectiveness study in active duty service members with chronic pain. Contemp Clin Trials Commun 13: 100311.

119. Karon F Cook, Michael A Kallen, Chester Buckenmaier, Diane M Flynn, Hanling SR, et al. (2017) Evaluation of the Validity and Response Burden of Patient Self-Report Measures of the Pain Assessment Screening Tool and Outcomes Registry (PASTOR). Military Medicine 182(7): e1851-e1861.

120. Wheeler RB (2014) How Pets Can Ease Chronic Pain. Medically Reviewed by Niya Jones. Web Everyday Health.

121. Thompson DJ (2011) Pet Therapy and Depression. Reviewed by Niya Jones. Web Everyday Health.

122. Calcaterra V, Veggiotti P, Palestrini C, De Giorgis, Raschetti R, et al. (2015) Post-operative benefits of animal-assisted therapy in pediatric surgery: a randomised study. P Lo S One 10(6): e0125813.

123. Dawn A Marcus, Cheryl D Bernstein, Janet M Constantin, Frank A Kunkel, Paula Breuer, et al. (2012) Animal-Assisted Therapy at an Outpatient Pain Management Clinic. Pain Medicine 13(1): 45–57.

124. Marcus DA, Bernstein CD, Constantin JM, Kunkel FA, Breuer P, et al. (2013) Impact of animal-assisted therapy for outpatients with fibromyalgia. Pain Med 14(1): 43-51.

125. Havey J, Vlasses F, Vlasses P, Ludwig P, et al. (2014) The Effect of Animal-Assisted Therapy on Pain Medication Use After Joint Replacement. Anthrozoos 27(3): 361-369.

126. Kline JA, Fisher MA, Pettit KL, Linville CT, Beck AM, et al. (2019) Controlled clinical trial of canine therapy versus usual care to reduce patient anxiety in the emergency department. P Lo S One 14(1): e0209232.

127. Klein M, Taphoorn MJ, Heimans JJ, Van der Ploeg HM, Vandertop WP et al. (2001) Neurobehavioral status and health-related quality of life in newly diagnosed high-grade glioma patients. J Clin Oncol 19(20): 4037–4047.

128. Brown PD, Ballman K, Rummans TA, Maurer MJ, Sloan JA, et al. (2006) Prospective study of quality of life in adults with newly diagnosed high-grade gliomas. J Neuro-Oncol 76(3): 283–291.

129. Petranek S, Pencek J, Dey M (2018) The Effect of Pet Therapy and Artist Interactions on Quality of Life in Brain Tumor Patients: A Cross-Section of Art and Medicine in Dialog. Behav Sci (Basel) 8(5): 43.

130. Gorji HM, Nesami BM, Ayyasi M, Ghafari R, Yazdani J, et al. (2014) Comparison of Ice Packs Application and Relaxation Therapy in Pain Reduction during Chest Tube Removal Following Cardiac Surgery. N Am J Med Sci 6(1): 19-24.

131. Nonpharmacological Interventions.

132. Positioning and Alignment Duty: Assist Client with Personal Hygiene Task.

133. Guidelines for The Management of Pain in Nigeria. Federal Ministry of Health Nigeria 2018.

134. Manuel F, Rosenbaum I, Rosenbaum EH. Physical Medicine Approaches to Pain Relief.

135. Linda R Van Dillen, Shirley A Sahrmann, Barbara J Norton, Cheryl A Caldwell, McDonnell MK, et al. (2003) The Effect of Modifying Patient-Preferred Spinal Movements and Alignment During Symptom Testing in Patients with Low Back Pain: A Preliminary Report. In Archives of Physical Medicine and Rehabilitation 84(3): 313-322.

136. Bush TR, Leitkam S, Aurino M, Cooper A, Basson MD, et al. (2015) A Comparison of Pressure Mapping Between Two Pressure-Reducing Methods for the Sacral Region. J Wound Ostomy Continence Nurs 42(4): 338-345.

137. Elkins G, Jensen MP, Patterson DR (2007) Hypnotherapy for the management of chronic pain. Int J Clin Exp Hypn 55(3): 275-287.

138. Shenefelt PD (2017) Use of hypnosis, meditation, and biofeedback in dermatology. Clin Dermatol 35(3): 285-291.

139. Lee JS, Pyun YD (2012) Use of hypnosis in the treatment of pain. Korean J Pain 25(2): 75-80.

140. Xie YF, Huo FQ, Tang JS (2008) Cerebral cortex modulation of pain. Acta Pharmacol Sin 30(1): 31-41.

141. Hu L, Zhang L, Chen R, Yu H, Li H, et al. (2015) The primary somatosensory cortex and the insula contribute differently to the processing of transient and sustained nociceptive and non-nociceptive somatosensory inputs. Hum Brain Mapp 36(11): 4346-4360.

142. Vogt BA (2005) Pain and emotion interactions in subregions of the cingulate gyrus. Nat Rev Neurosci 6(7): 533-544.

143. Raz A, Fan J, Posner MI (2005) Hypnotic suggestion reduces conflict in the human brain. PNAS 102(28): 9978-9983.

144. Jensen MP, Day MA, Miró J (2014) Neuromodulatory treatments for chronic pain: efficacy and mechanisms. Nat Rev Neurol 10(3): 167-178.

145. Rizzo RRN, Medeiros FC, Pires LG, Pimenta RM, McAuley JH, et al. (2018) Hypnosis Enhances the Effects of Pain Education in Patients with Chronic Nonspecific Low Back Pain: A Randomized Controlled Trial. J Pain 19(10): 1103.e1-1103.e9.

146. Chen X, Yuan R, Chen X (2018) Hypnosis intervention for the management of pain perception during cataract surgery. J Pain Res 11: 1921-1926.

147. Brugnoli MP, Pesce G, Pasin E, Basile MF, , Tamburin S, et al. (2018) The role of clinical hypnosis and self-hypnosis to relief pain and anxiety in severe chronic diseases in palliative care: a 2-year long-term follow-up of treatment in a nonrandomized clinical trial. Ann Palliat Med 7(1): 17-31.

148. Miles J (1984) Electrical stimulation for the relief of pain. Ann R Coll Surg Engl 66(2): 108-112.

149. Web Medline Plus. Non-Drug Pain Management.

150. Arthritis Foundation. Electrical Nerve Stimulation for Arthritis Pain.

151. (2011) ELECTROPHYSICAL AGENTS - Contraindications and Precautions: An Evidence-Based Approach To Clinical Decision Making In Physical Therapy. Physiother Can 62(5): 1-80.

152. Sears B (2018) Types of Electrical Stimulation Used in Physical Therapy. Reviewed by Richard N Fogoros, MD Web Verywellhealth.

153. C Zeng, H li, T Yang, Z h Deng, Y Yang, et al. (2014) Electrical stimulation for pain relief in knee osteoarthritis: systematic review and network meta-analysis. Osteoarthritis and Cartilage 23(2): 189-202.

154. Nayak R, Banik RK (2018) Current Innovations in Peripheral Nerve Stimulation. Pain Res Treat 9091216.

155. Current Procedural Terminology. Implanted Peripheral Nerve Stimulator (PNS) for Pain Control. Medical Policy American Medical Association (AMA).

156. Nguyen VQ, Bock WC, Groves CC, et al. Fully implantable peripheral nerve stimulation for the treatment of hemiplegic shoulder pain: a case report. Am J Phys Med Rehabil 94(2): 146-153.

157. Gofeld M, Agur A (2018) Peripheral Nerve Stimulation for Chronic Shoulder Pain: A Proof of Concept Anatomy Study. Neuromodulation 21(3): 284-289.

158. Wilson RD, Bennett ME, Nguyen VQC, Bock WC, O'Dell MW, et al. Fully Implantable Peripheral Nerve Stimulation for Hemiplegic Shoulder Pain: A Multi-Site Case Series with Two-Year Follow-Up. Neuromodulation 21(3): 290-295.

159. Audette JF, Bailey A (2007) Complementary and Alternative Medicine and the Athlete. Clinical Sports Medicine Pp. 307-320.

160. Lerman I R, Chen JL, Hiller D, Souzdalnitski D, Sheean G, et al. (2015) Novel High-Frequency Peripheral Nerve Stimulator Treatment of Refractory Postherpetic Neuralgia: A Brief Technical Note. Neuromodulation: Technology at the Neural Interface 18(6): 487–493.

161. Günter C, Delbeke J, Ortiz-Catalan M (2019) Safety of long-term electrical peripheral nerve stimulation: review of the state of the art. J Neuroeng Rehabil 16(1): 13.

162. Lee B, Koripalli MK, Jia Y, Acosta J, Sendi MSE, et al. An Implantable Peripheral Nerve Recording and Stimulation System for Experiments on Freely Moving Animal Subjects. Scientific Reportsvolume 8(1): 6115.

163. Andrew G. Shetter, Gabor B Racz, Royce Lewis, JE Heavner (1996) Chapter 16. Peripheral Nerve Stimulation. In. Richard B. North, Robert M. Levy. Neurosurgical Management of Pain by Springer Science & Business Media.

164. Lake DA (1992) Neuromuscular electrical stimulation. An overview and its application in the treatment of sports injuries. Sports Med 13(5): 320-336.

165. Web Cincinnati, Ohio Occupational Therapy and Physical Therapy. Neuromuscular Electrical Stimulation (NMES) / Neuroprosthetics.

166. Dirks ML, Wall BT, Snijders T, Ottenbros CL, Verdijk LB, et al. (2014) Neuromuscular electrical stimulation prevents muscle disuse atrophy during leg immobilization in humans. Acta Physiol (Oxf) 210(3): 628-641.

167. Jones S, Man WD, Gao W, Higginson IJ, Wilcock A, et al. (2016) Neuromuscular electrical stimulation for muscle weakness in adults with advanced disease. Cochrane Database Syst Rev 10: CD009419.

168. Iwatsu K, Iida Y, Kono Y, Yamazaki T, Usui A, et al. Neuromuscular electrical stimulation may attenuate muscle proteolysis after cardiovascular surgery: A preliminary study. J Thorac Cardiovasc Surg 153(2): 373-379.

169. Fischer A, Winkler A, Spiegl M, A Salamon, K Altmann, et al. (2015) Effects of neuromuscular electrical stimulation on muscle mass and strength in critically ill patients after cardiothoracic surgery (catastim 2). Intensive Care Med Exp 3(1): A818.

170. Iwatsu K, Yamada S, Iida Y, Sampei H, Kobayashi K, et al. (2015) Feasibility of neuromuscular electrical stimulation immediately after cardiovascular surgery. Arch Phys Med Rehabil 96(1): 63-68.

171. Sachetti A, Carpes MF, Dias AS, Sbruzzi G (2018) Safety of neuromuscular electrical stimulation among critically ill patients: systematic reviewSegurança no uso da eletroestimulação neuromuscular em pacientes graves: revisão sistemática. Rev Bras Ter Intensiva 30(2): 219-225.

172. Pugliese JM, Sions JM, Velasco TO, Hicks GE (2018) Use of trunk muscle training and neuromuscular electrical stimulation to reduce pain and disability in an older adult with chronic low back pain: A case report. Physiother Theory Pract 4: 1-8.

173. Li YP, Cui X, Liu SC, Zhang SH, Zhao YH (2018) Neuromuscular electrical stimulation for treating postpartum low back pain. Medicine (Baltimore) 97(28): e11426.

174. Xiao xian G, Bai ya F, Yan yang M (2018) Effectiveness of neuromuscular electrical stimulation for wrist rehabilitation after acute ischemic stroke. Medicine 97(38): e12299.

175. Carnaby Mann GD, Crary MA (2007) Examining the Evidence on Neuromuscular Electrical Stimulation for Swallowing: A Meta-analysis. Arch Otolaryngol Head Neck Surg 133(6): 564–571.

176. Zhang YB, Cheng YN (2019) A randomized controlled trial of neuromuscular electrical stimulation for chronic urinary retention following traumatic brain injury. Medicine (Baltimore) 98(2): e14106.

177. Miller S, Jungheim M, Kühn D, Ptok M (2013) Electrical Stimulation in Treatment of Pharyngolaryngeal Dysfunctions. Folia Phoniatr Logop 65(3): 154-168.

178. Moore SR, Shurman J (1997) Combined neuromuscular electrical stimulation and transcutaneous electrical nerve stimulation for treatment of chronic back pain: a double-blind, repeated measures comparison. Arch Phys Med Rehabil 78(1): 55-60.

179. Chen FC, Shao HL, Han FL (2018) A pilot study of neuromuscular electrical stimulation for neuropathic pain caused by spinal cord injury. Medicine (Baltimore) 97(31): e11658.

180. Zhou M, Li F, Lu W, Wu J, Pei S (2018) Efficiency of Neuromuscular Electrical Stimulation and Transcutaneous Nerve Stimulation on Hemiplegic Shoulder Pain: A Randomized Controlled Trial. Arch Phys Med Rehabil 99(9): 1730-1739.

181. Martimbianco ALC, Torloni MR, Andriolo BN, Porfírio GJ, Riera R (2017) Neuromuscular electrical stimulation (NMES) for patellofemoral pain syndrome. Cochrane Database Syst Rev 12: CD011289.

182. Vaz MA, Baroni BM, Geremia JM, Lanferdini FJ, Mayer A, et al. (2013) Neuromuscular electrical stimulation (NMES) reduces structural and functional losses of quadriceps muscle and improves health status in patients with knee osteoarthritis. J Orthop Res 31(4): 511-516.

183. Imoto AM, Peccin MS, Teixeira LE, Silva KN, Abrahão M, et al. (2013) Is neuromuscular electrical stimulation effective for improving pain, function and activities of daily living of knee osteoarthritis patients? A randomized clinical trial. Sao Paulo Med J 131(2): 80-87.

184. Guo P, Wang JW, Tong A (2018) Therapeutic effectiveness of neuromuscular electrical stimulation for treating patients with chronic low back pain. Medicine (Baltimore) 97(48): e13197.

185. F MacPherson, L Colvin (2015) Transcutaneous Electrical Nerve Stimulation (TENS). Research to support clinical practice, BJA: British Journal of Anaesthesia 114(4): 711–712.

186. Teoli D, An J (2019) Transcutaneous Electrical Nerve Stimulation (TENS). StatPearls [Internet].

187. Tashani O, Johnson M (2009) Transcutaneous Electrical Nerve Stimulation (TENS) A Possible Aid for Pain Relief in Developing Countries?. Libyan J Med 4(2): 62-65.

188. Segura R (1985) Clinical Transcutaneous Electrical Nerve Stimulation. JAMA 253(14): 2138.

189. Berkman R (1999) Percutaneous Electrical Nerve Stimulation for Treatment of Low Back Pain. JAMA 282(10): 941–942.

190. Ghoname EA, Craig WF, White PF, Ahmed HE, Hamza MA (1999) Percutaneous electrical nerve stimulation for low back pain: a randomized crossover study. JAMA 281(9): 818-823.

191. Johnson MI, Jones G (2017) Transcutaneous electrical nerve stimulation: current status of evidence. Pain Manag 7(1): 1–4.

192. Ebrahimian M, Razeghi M, Zamani A, Bagheri Z, Rastegar K (2018) Does High Frequency Transcutaneous Electrical Nerve Stimulation (TENS) Affect EEG Gamma Band Activity?. J Biomed Phys Eng 8(3): 271-280.

193. Grover CA, McKernan MP, Close RJH (2018) Transcutaneous Electrical Nerve Stimulation (TENS) in the Emergency Department for Pain Relief: A Preliminary Study of Feasibility and Efficacy. West J Emerg Med 19(5): 872-876.

194. Mahmood A, Veluswamy SK, Hombali A, Mullick A, N M, et al. (2019) Effect of Transcutaneous Electrical Nerve Stimulation on Spasticity in Adults With Stroke: A Systematic Review and Meta-analysis. Arch Phys Med Rehabil 100(4): 751-768.

195. Kwong PW, Ng GY, Chung RC, Ng SS (2018) Transcutaneous electrical nerve stimulation improves walking capacity and reduces spasticity in stroke survivors: a systematic review and meta-analysis. Clin Rehabil 32(9): 1203-1219.

196. Chen FC, Jin ZL, Wang DF (2018) A retrospective study of transcutaneous electrical nerve stimulation for chronic pain following ankylosing spondylitis. Medicine (Baltimore) 97(27): e11265.

197. Almeida CC, Silva VZMD, Júnior GC, Liebano RE, Durigan JLQ (2018) Transcutaneous electrical nerve stimulation and interferential current demonstrate similar effects in relieving acute and chronic pain: a systematic review with meta-analysis. Braz J Phys Ther 22(5): 347-354.

198. Zimmerman LL, Gupta P, O'Gara F, Langhals NB, Berger MB (2018) Transcutaneous Electrical Nerve Stimulation to Improve Female Sexual Dysfunction Symptoms: A Pilot Study. Neuromodulation 21(7): 707-713.

199. Constant I, Sabourdin N (2012) The EEG signal: a window on the cortical brain activity. Paediatr Anaesth 22(6): 539-552.

200. Martinovic J, Busch NA (2011) High frequency oscillations as a correlate of visual perception. Int J Psychophysiol 79(1): 32-38.

201. Zhang ZG, Hu L, Hung YS, Mouraux A, Iannetti GD (2012) Gamma-band oscillations in the primary somatosensory cortex--a direct and obligatory correlate of subjective pain intensity. J Neurosci 32(22): 7429-7438.

202. Chen AC, Herrmann CS (2001) Perception of pain coincides with the spatial expansion of electroencephalographic dynamics in human subjects. Neurosci Lett 297(3): 183-186.

203. García-Pérez S, García-Ríos MC, Pérez-Mármol JM, Tapia-Haro RM, Albornoz-Cabello M, et al. (2018) Effectiveness of Transcutaneous Electrical Nerve Stimulation Energy in Older Adults: A Pilot Clinical Trial. Adv Skin Wound Care 31(10): 462-469.

204. Megía García Á, Serrano-Muñoz D, Bravo-Esteban E, Ando Lafuente S, Avendaño-Coy J et al. (2018) [Analgesic effects of transcutaneous electrical nerve stimulation (TENS) in patients with fibromyalgia: A systematic review]. Aten Primaria pii: S0212-6567(17)30682-0.

205. Tao H, Wang T, Dong X, Guo Q, Xu H, et al. (2018) Effectiveness of transcutaneous electrical nerve stimulation for the treatment of migraine: a meta-analysis of randomized controlled trials. J Headache Pain 19(1): 42.

206. Asgari Z, Tavoli Z, Hosseini R, Nataj M, Tabatabaei F,et al. (2018) A Comparative Study between Transcutaneous Electrical Nerve Stimulation and Fentanyl to Relieve Shoulder Pain during Laparoscopic Gynecologic Surgery under Spinal Anesthesia: A Randomized Clinical Trail. Pain Res Manag 2018: 9715142.

207. Marcolino MAZ, Hauck M, Stein C, Schardong J, Pagnussat AS, et al. (2018) Effects of transcutaneous electrical nerve stimulation alone or as additional therapy on chronic post-stroke spasticity: systematic review and meta-analysis of randomized controlled trials. Disabil Rehabil pp: 1-13.

208. Sadala AY, Machado AFP, Liebano RE (2018) Effects of transcutaneous electrical nerve stimulation on pain intensity during application of carboxytherapy in patients with cellulite: A randomized placebo-controlled trial. J Cosmet Dermatol 17(6): 1175-1181.

209. Kong X, Gozani SN (2018) Effectiveness of fixed-site high-frequency transcutaneous electrical nerve stimulation in chronic pain: a large-scale, observational study. J Pain Res 11: 703-714.

210. Shimoura K, Iijima H, Suzuki Y, Aoyama T (2019) Immediate Effects of Transcutaneous Electrical Nerve Stimulation on Pain and Physical Performance in Individuals With Preradiographic Knee Osteoarthritis: A Randomized Controlled Trial. Arch Phys Med Rehabil 100(2): 300-306.

211. WebMD LLC Chiropractic Care for Back Pain.

212. B. Miller (2012) Oxford Handbook of Pain Management. British Journal of Anaesthesia 108(1): 172.

213. A.C. BREEN (1977) CHIROPRACTORS AND THE TREATMENT OF BACK PAIN. Rheumatology 16(1): 46–53.

214. Web Harvard Health Publishing (2018) Chiropractic care for pain relief.

215. Gevirtz R, Beltran R. Biofeedback for Chronic Pain. In: Robert A Bonakdar & Andrew W Sukiennik (Eds.), Integrative Pain Management.

216. Lawrence H. Wyatt (2004) Handbook of Clinical Chiropractic Care.

217. Lefebvre R, Peterson D, Haas M (2012) Evidence-Based Practice and Chiropractic Care. J Evid Based Complementary Altern Med 18(1): 75-79.

218. Gedin F, Skeppholm M, Burström K, Sparring V, Tessma M, et al. (2017) Effectiveness, costs and cost-effectiveness of chiropractic care and physiotherapy compared with information and advice in the treatment of non-specific chronic low back pain: study protocol for a randomised controlled trial. Trials 18(1): 613.

219. Innes SI, Werth PD, Tuchin PJ, Graham PL (2015) Attitudes and beliefs of Australian chiropractors' about managing back pain: a cross-sectional study. Chiropr Man Therap 23: 17.

220. Dagenais S (2013) Why not everyone with low back pain chooses chiropractic care. J Can Chiropr Assoc 57(1): 6-9.

221. Nahin RL, Boineau R, Khalsa PS, Stussman BJ, Weber WJ (2016) Evidence-Based Evaluation of Complementary Health Approaches for Pain Management in the United States. Mayo Clin Proc 91(9) :1292-1306.

222. Evans R, Haas M, Schulz C, Leininger B, Hanson L, et al. (2018) Spinal manipulation and exercise for low back pain in adolescents: a randomized trial. Pain 159(7): 1297-1307.

223. Ernst E, Canter PH (2003) Chiropractic spinal manipulation treatment for back pain: a systematic review of randomized clinical trials. Physical Therapy Reviews 8: 85-91.

224. Pagé I, Descarreaux M (2019) Effects of spinal manipulative therapy biomechanical parameters on clinical and biomechanical outcomes of participants with chronic thoracic pain: a randomized controlled experimental trial. BMC Musculoskelet Disord 20(1): 29.

225. Evans RC, Rosner AL (2005) Alternatives in cancer pain treatment: the application of chiropractic care. Semin Oncol Nurs 21(3): 184-189.

226. Schneider J, Gilford S (2001) The chiropractor's role in pain management for oncology patients. J Manipulative Physiol Ther 24(1): 52-57.

227. Ernst E (2003) Chiropractic spinal manipulation for neck pain: a systematic review. The Journal of Pain 4: 417–21.

228. Schneider M, Vernon H, Ko G, Lawson G, Perera J (2009) Chiropractic management of fibromyalgia syndrome: a systematic review of the literature. Journal of Manipulative and Physiological Therapeutics 32: 25-40.

229. Riva JJ, Muller GD, Hornich AA, Mior SA, Gupta A, et al. (2010) Chiropractors and collaborative care: An overview illustrated with a case report. J Can Chiropr Assoc 54(3): 147-154.

230. Patil S, Sen S, Bral M, Reddy S, Bradley KK, et al. (2016) The Role of Acupuncture in Pain Management. Curr Pain Headache Rep 20(4): 22.

231. Jonathan Wilkinson, Richard Faleiro (2007) Acupuncture in pain management. Continuing Education in Anaesthesia Critical Care & Pain. 7(4): 135-138.

232. MacPherson H, White A, Cummings M, Jobst KA, Rose K, et al. (2002) Standards for Reporting Interventions in Controlled Trials of Acupuncture: the STRICTA recommendations. J Altern Complement Med 8(1): 85-89.

233. Vickers AJ, Linde K (2014) Acupuncture for chronic pain. JAMA 311(9): 955-956.

234. Chou R, Qaseem A, Snow V, Casey D, Cross JT Jr, et al. (2007) Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. Ann Intern Med 147(7): 478-491.

235. National Institute for Health and Clinical Excellence Headaches: Diagnosis and management of headaches in young people and adults, 2012.

236. Lu SC, Zheng Z, Xue CC (2011) Does acupuncture improve quality of life for patients with pain associated with the spine? A systematic review. Evid Based Complement Alternat Med 2011: 301767.

237. Conaghan PG, Dickson J, Grant RL (2008) Care and management of osteoarthritis in adults: summary of NICE guidance. BMJ 336(7642): 502–503.

238. American Academy of Orthopaedic Surgeons. Evidence Based Guideline. 2nd Edition (2013) Treatment of Osteoarthritis of the Knee.

239. Vickers AJ, Cronin AM, Maschino AC, Lewith G, MacPherson H, et al. (2012) Acupuncture for chronic pain: individual patient data meta-analysis. Arch Intern Med 172(19): 1444-1453.

240. Vickers AJ, Vertosick EA, Lewith G, MacPherson H, Foster NE, et al. (2018) Acupuncture for Chronic Pain: Update of an Individual Patient Data Meta-Analysis. J Pain 19(5): 455-474.

241. Scott D Mist, Kim Dupree Jones (2018) Randomized Controlled Trial of Acupuncture for Women with Fibromyalgia: Group Acupuncture with Traditional Chinese Medicine Diagnosis-Based Point Selection. Pain Medicine 19(9): 1862–1871.

242. Yang B, Yi G, Hong W, Bo C, Wang Z, et al. (2014) Efficacy of acupuncture on fibromyalgia syndrome: a meta-analysis. J Tradit Chin Med 34(4): 381-391.

243. Wu MS, Chen KH, Chen IF, Huang SK, Tzeng PC, et al. (2016) The Efficacy of Acupuncture in Post-Operative Pain Management: A Systematic Review and Meta-Analysis. PLoS One 11(3): e0150367.

244. Jung JY, Cho JH, Chung SH (2015) Acupuncture for postoperative pain following total knee arthroplasty: a systematic review protocol. BMJ Open 5(11): e009573.

245. Web Conference Series LLC Ltd. Physical Therapy Rehabilitation Conferences.

246. Morris DM, Jenkins GR (2018) Preparing Physical and Occupational Therapists to Be Health Promotion Practitioners: A Call for Action. Int J Environ Res Public Health 15(2): 392.

247. Jiandani MP, Mhatre BS (2018) Physical therapy diagnosis: How is it different?. J Postgrad Med 64(2): 69-72.

248. Lein DH Jr, Clark D, Graham C, Perez P, Morris D (2017) A Model to Integrate Health Promotion and Wellness in Physical Therapist Practice: Development and Validation. Phys Ther 97(12): 1169-1181.

249. Richardson RW (2015) Ethical issues in physical therapy. Curr Rev Musculoskelet Med 8(2): 118-121.

250. Coronado RA, Bialosky JE (2017) Manual physical therapy for chronic pain: the complex whole is greater than the sum of its parts. J Man Manip Ther 25(3): 115-117.

251. Pullen S (2017) Physical therapy as non-pharmacological chronic pain management of adults living with HIV: self-reported pain scores and analgesic use. HIV AIDS (Auckl) 9: 177-182.

252. Fransen M, McConnell S, Harmer AR, Van der Esch M, Simic M, et al. (2015) Exercise for osteoarthritis of the knee: a Cochrane systematic review. Br J Sports Med 49(24): 1554–1557.

253. Joelsson M, Bernhardsson S, Larsson ME (2017) Patients with chronic pain may need extra support when prescribed physical activity in primary care: a qualitative study. Scand J Prim Health Care 35(1): 64-74.

254. Schmitt YS, Hoffman HG, Blough DK, Patterson DR, Jensen MP, et al. (2010) A randomized, controlled trial of immersive virtual reality analgesia, during physical therapy for pediatric burns. Burns 37(1): 61-68.

255. Chan HBY, Pua PY, How CH (2017) Physical therapy in the management of frozen shoulder. Singapore Med J 58(12): 685-689.

256. Shroff G, Thakur D, Dhingra V, Baroli DS, Khatri D et al. (2016) Role of physiotherapy in the mobilization of patients with spinal cord injury undergoing human embryonic stem cells transplantation. Clin Transl Med 5(1): 41.

257. Nketia-Kyere M, Aryeetey GC, Nonvignon J, Aikins M (2017) Exploring barriers to accessing physiotherapy services for stroke patients at Tema general hospital, Ghana. Arch Physiother 7: 8.

258. Piano L, Maselli F, Viceconti A, Gianola S, Ciuro A (2017) Direct access to physical therapy for the patient with musculoskeletal disorders, a literature review. J Phys Ther Sci 29(8): 1463-1471.

259. Bennell KL, Spiers L, Takla A, O'Donnell J, Kasza J, et al. (2017) Efficacy of adding a physiotherapy rehabilitation programme to arthroscopic management of femoroacetabular impingement syndrome: a randomised controlled trial (FAIR). BMJ Open 7(6): e014658.

260. Abdel-Aziem AA, Soliman ES, Mosaad DM, Draz AH (2018) Effect of a physiotherapy rehabilitation program on knee osteoarthritis in patients with different pain intensities. J Phys Ther Sci 30(2): 307-312.

261. Gijbels D, Lamers I, Kerkhofs L, Alders G, Knippenberg E, et al. (2011) The Armeo Spring as training tool to improve upper limb functionality in multiple sclerosis: a pilot study. J Neuroeng Rehabil 8: 5.

262. Chang DG, Holt JA, Sklar M, Groessl EJ (2016) Yoga as a treatment for chronic low back pain: A systematic review of the literature. J Orthop Rheumatol 3(1): 1-8.

263. Byrne J, Schütze R. Yoga and pain. Web painHEALTH.

264. Cramer H, Lauche R, Haller H, Dobos G (2013) A systematic review and meta-analysis of yoga for low back pain. The Clinical journal of pain 29(5): 450-460.

265. Cramer H, Ward L, Saper R, Fishbein D, Dobos G, et al. (2015) The Safety of Yoga: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Am J Epidemiol 182(4): 281-293.

266. Sulenes K, Freitas J, Justice L, Colgan DD, Shean M, et al. (2015) Underuse of yoga as a referral resource by health professions students. J Altern Complement Med 21(1): 53-59.

267. Wren AA, Wright MA, Carson JW, Keefe FJ (2011) Yoga for persistent pain: new findings and directions for an ancient practice. Pain 152(3):477-480.

268. Deshpande A (2018) Yoga for palliative care. Integr Med Res 7(3): 211-213.

269. Vallath N (2010) Perspectives on yoga inputs in the management of chronic pain. Indian J Palliat Care 16(1): 1-7.

270. Wieland LS, Skoetz N, Pilkington K, Vempati R, D'Adamo CR (2017) Yoga treatment for chronic non-specific low back pain. Cochrane Database Syst Rev 1: CD010671.

271. Lee M, Moon W, Kim J (2014) Effect of yoga on pain, brain-derived neurotrophic factor, and serotonin in premenopausal women with chronic low back pain. Evid Based Complement Alternat Med 2014: 203173.

272. Ward L, Stebbings S, Cherkin D, Baxter GD (2013) Yoga for functional ability, pain and psychosocial outcomes in musculoskeletal conditions: a systematic review and meta-analysis. Musculoskeletal Care 11(4): 203-217.

273. Curtis K, Osadchuk A, Katz J (2011) An eight-week yoga intervention is associated with improvements in pain, psychological functioning and mindfulness, and changes in cortisol levels in women with fibromyalgia. J Pain Res 4: 189-201.

274. Carson JW, Carson KM, Jones KD, Mist SD, Bennett RM (2012) Follow-up of yoga of awareness for fibromyalgia: results at 3 months and replication in the wait-list group. Clin J Pain 28(9): 804-813.

275. Kisan R, Sujan M, Adoor M, Rao R, Nalini A, et al. (2014) Effect of Yoga on migraine: A comprehensive study using clinical profile and cardiac autonomic functions. Int J Yoga 7(2): 126-132.

276. Amin FM, Aristeidou S, Baraldi C, Czapinska-Ciepiela EK, Ariadni DD, et al. (2018) The association between migraine and physical exercise. J Headache Pain 19(1): 83.

277. Ghasemi GA, Golkar A, Marandi SM (2013) Effects of hata yoga on knee osteoarthritis. Int J Prev Med 4(1): S133-S138.

278. Di Monaco M, Di Monaco R, Manca M, Cavanna A (2000) Handgrip strength is an independent predictor of distal radius bone mineral density in postmenopausal women. Clin Rheumatol 19(6): 473–476.

279. Deepeshwar S, Tanwar M, Kavuri V, Budhi RB (2018) Effect of Yoga Based Lifestyle Intervention on Patients With Knee Osteoarthritis: A Randomized Controlled Trial. Front Psychiatry 9: 180.

280. Kolasinski SL, Garfinkel M, Tsai AG, Matz W, Van Dyke A, et al. (2005) Iyengar yoga for treating symptoms of osteoarthritis of the knees: a pilot study. J Altern Complement Med 11: 689–693.

281. Wang Y, Lu S, Wang R, Jiang P, Rao F, et al. (2018) Integrative effect of yoga practice in patients with knee arthritis: A PRISMA-compliant meta-analysis. Medicine (Baltimore) 97(31): e11742.

282. Cheung C, Wyman JF, Bronas U, McCarthy T, Rudser K, et al. (2017) Managing knee osteoarthritis with yoga or aerobic/strengthening exercise programs in older adults: a pilot randomized controlled trial. Rheumatol Int 37(3): 389-398.

283. Vijayaraghava A, Doreswamy V, Narasipur OS, Kunnavil R, Srinivasamurthy N (2015) Effect of Yoga Practice on Levels of Inflammatory Markers After Moderate and Strenuous Exercise. J Clin Diagn Res 9(6): CC08-CC12.

284. Khan AA, Srivastava A, Passi D, Devi M, Chandra L, et al. (2018) Management of myofascial pain dysfunction syndrome with meditation and yoga: Healing through natural therapy. Natl J Maxillofac Surg 9(2): 155-159.

285. Saxena R, Gupta M, Shankar N, Jain S, Saxena A (2017) Effects of yogic intervention on pain scores and quality of life in females with chronic pelvic pain. Int J Yoga 10(1): 9-15.

286. Agarwal RP, Maroko-Afek A (2018) Yoga into Cancer Care: A Review of the Evidence-based Research. Int J Yoga 11(1): 3-29.

287. Côté A, Daneault S (2012) Effect of yoga on patients with cancer: our current understanding. Can Fam Physician 58(9): e475-e479.

288. McCall M, Thorne S, Ward A, Heneghan C (2015) Yoga in adult cancer: an exploratory, qualitative analysis of the patient experience. BMC Complement Altern Med 15: 245.

289. Jewell T (2018) What Is Diaphragmatic Breathing? Medically reviewed by Debra Rose Wilson, Web Healthline.

290. Li Y, Wang R, Tang J, Tan L, Wu Z, et al. (2015) Progressive muscle relaxation improves anxiety and depression of pulmonary arterial hypertension patients. Evid Based Complement Alternat Med 2015: 792895.

291. Sundram BM, Dahlui M, Chinna K (2015) Effectiveness of progressive muscle relaxation therapy as a worksite health promotion program in the automobile assembly line. Ind Health 54(3): 204-214.

292. Hashim HA, Hanafi Ahmad Yusof H (2011) The effects of progressive muscle relaxation and autogenic relaxation on young soccer players' mood states. Asian J Sports Med 2(2): 99-105.

293. Peper E Autogenic Training: An Integrated Approach with Biofeedback for Approach with Biofeedback for Supporting Health.

294. Menzies V, Taylor AG, Bourguignon C (2006) Effects of guided imagery on outcomes of pain, functional status, and self-efficacy in persons diagnosed with fibromyalgia. J Altern Complement Med 12(1): 23-30.

295. Blödt S, Pach D, Roll S, Witt CM (2014) Effectiveness of app-based relaxation for patients with chronic low back pain (Relaxback) and chronic neck pain (Relaxneck): study protocol for two randomized pragmatic trials. Trials 15: 490.

296. Alodaibi FA, Fritz JM, Thackeray A, Koppenhaver SL, Hebert JJ (2018) The Fear Avoidance Model predicts short-term pain and disability following lumbar disc surgery. PLoS One 13(3): e0193566.

297. Meier ML, Stämpfli P, Humphreys BK, Vrana A, Seifritz E, et al. (2017) The impact of pain-related fear on neural pathways of pain modulation in chronic low back pain. PAIN Reports 2(3): pe601.

298. Lim JA, Choi SH, Lee WJ, Moon JY, Kim YC, Kang DH, et al. (2018) Cognitive-behavioral therapy for patients with chronic pain: Implications of gender differences in empathy. Medicine (Baltimore) 97(23): e10867.

299. Song MK, Choi SH, Lee DH, Lee KJ, Lee WJ, et al. (2018) Effects of Cognitive-Behavioral Therapy on Empathy in Patients with Chronic Pain. Psychiatry Investig 15(3): 285-291.

300. Zanini S, Voltolini A, Gragnano G, Fumagalli E, Pagnini F (2018) Changes in Pain Perception following Psychotherapy: The Mediating Role of Psychological Components. Pain Res Manag 2018: 8713084.

301. Pigeon WR, Moynihan J, Matteson-Rusby S, et al. (2012) Comparative effectiveness of CBT interventions for co-morbid chronic pain & insomnia: a pilot study. Behav Res Ther 50(11): 685-689.

302. Feliu-Soler A, Montesinos F, Gutiérrez-Martínez O, Scott W, McCracken LM, et al. (2018) Current status of acceptance and commitment therapy for chronic pain: a narrative review. J Pain Res 11: 2145-2159.

303. Worley SL (2016) New Directions in the Treatment of Chronic Pain: National Pain Strategy Will Guide Prevention, Management, and Research. P T 41(2): 107-114.

304. Ambrose KR, Golightly YM (2015) Physical exercise as non-pharmacological treatment of chronic pain: why and when. Best Pract Res Clin Rheumatol 29(1): 120-130.

305. Evaluation of the TRICARE Program: Fiscal Year 2018 Report to Congress Access, Cost, and Quality Data through Fiscal Year 2017 (2018).

306. Flynn D M, Eaton LH, Mc Quinn H, Ashley Alden, Alexa R.Meins, et al. (2017) TelePain: Primary Care Chronic Pain Management through Weekly Didactic and Case-based Telementoring. Contemp Clin Trials Commun 8: 162-166.

307. Atlas SJ, Deyo RA (2001) Evaluating and managing acute low back pain in the primary care setting. J Gen Intern Med 16(2): 120-131.

308. Middleton C (2003) Understanding the physiological effects of unrelieved pain. Nurs Times 99(37): 28-31.

309. Sessle B (2011) Unrelieved pain: a crisis. Pain Res Manag 16(6): 416-420.

310. Louriz M, Belayachi J, Armel B, Dendane T, Abidi K, et al. (2014) Factors associated to unrelieved pain in a Morrocan Emergency Department. Int Arch 7(1): 48.

311. Chorney JM, Mc Grath P, Finley GA (2010) Pain as the neglected adverse event. CMAJ 182(7): 732.

312. Baratta JL, Schwenk ES, Viscusi ER (2014) Clinical consequences of inadequate pain relief: barriers to optimal pain management. Plast Reconstr Surg 134(4 Suppl 2): 15S-21S.

313. Raymond Sinatra (2010) Causes and Consequences of Inadequate Management of Acute Pain, Pain Medicine 11(12): 1859–1871.

314. Berdine HJ (2005) Neuropathic Pain: Diagnosis, Treatment, and the Pharmacist's Role in Patient Care. Web Pharmacy Times®

315. Non-Drug Pain Management. Web U.S. National Library of Medicine.

316. Johnson M (2007) Transcutaneous Electrical Nerve Stimulation: Mechanisms, Clinical Application and Evidence. Rev Pain 1(1): 7-11.

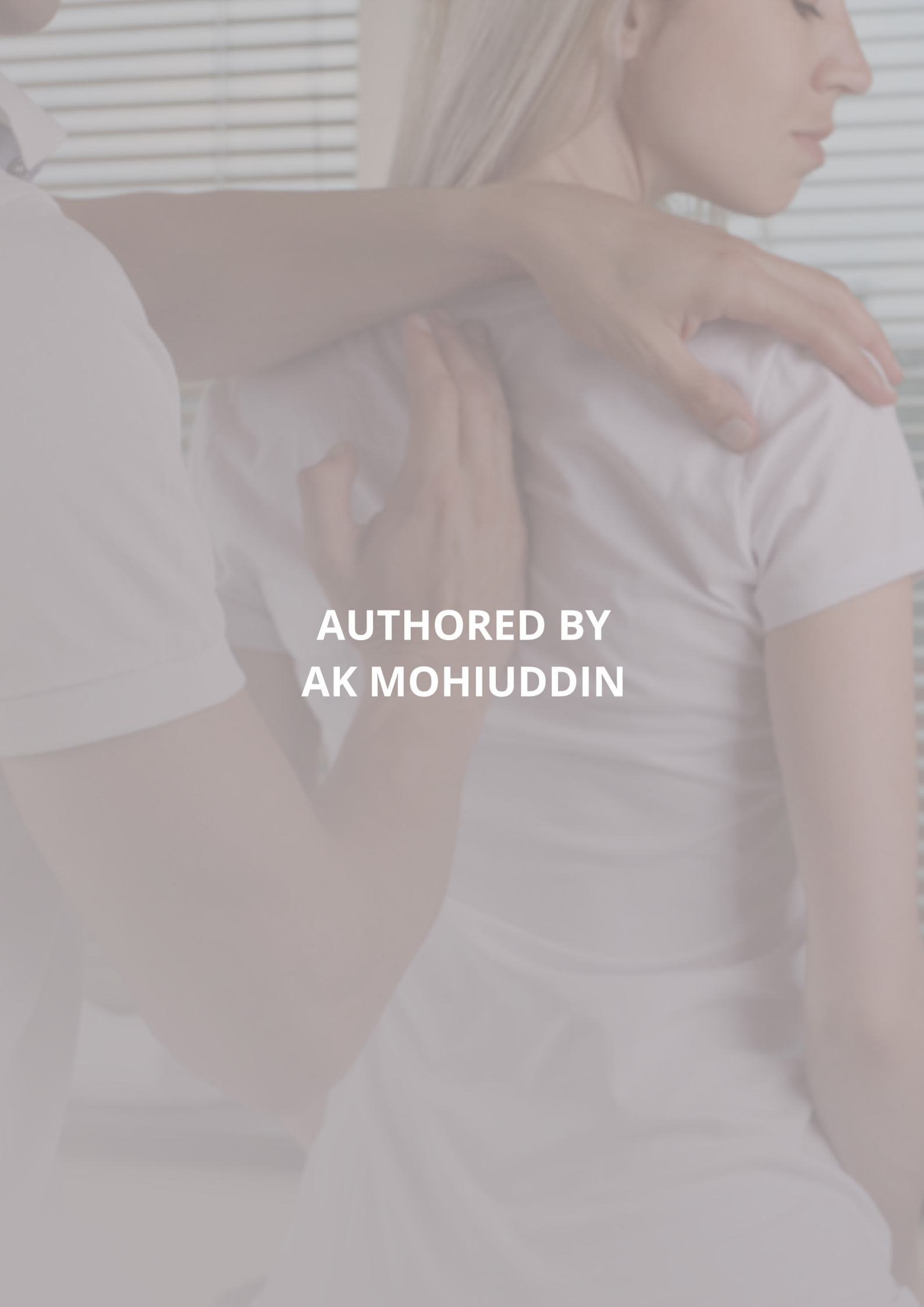
317. Kathleen A Sluka, Jan M Bjordal, Serge Marchand, Barbara A Rakel (2013) What Makes Transcutaneous Electrical Nerve Stimulation Work? Making Sense of the Mixed Results in the Clinical Literature. Physical Therapy 93(10): 1397–1402.

318. White PF, Craig WF (1999) Percutaneous Electrical Nerve Stimulation for Treatment of Low Back Pain—Reply. JAMA 282(10): 941–942.

319. Johnson MI, Mulvey MR, Bagnall AM (2015) Transcutaneous electrical nerve stimulation (TENS) for phantompain and stump pain following amputation in adults. Cochrane Database of Systematic Reviews (5): CD007264.

320. Johnson MI (2011) Transcutaneous Electrical Nerve Stimulation and Acupuncture. In: Cathy Stannard, et al. (Eds.), Evidence-Based Chronic Pain Management (Chapter 27), John Wiley & Sons.

321. Tousignant-Laflamme Y, Martel MO, Joshi AB, Cook CE (2017) Rehabilitation management of low back pain - it's time to pull it all together!. J Pain Res 10: 2373-2385.



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