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Physiotherapy for Clients with Complex Regional Pain Syndrome (CRPS)

Independent Learning Material for Physiotherapy Students

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Physiotherapy for Clients with Complex Regional Pain Syndrome (CRPS)- Independent Learning Material for SAMK Physiotherapy Students

Degree Programme in Physiotherapy

Complex Regional Pain Syndrome (CRPS) is a neuroinflammatory syndrome which main symptom is severe pain that is not in proportion to the time and degree to the existing trauma. Pain is regional and typically starts after a trauma or a surgery in an extremity. Other symptoms are swelling, vascular and trophic changes, and functional impairment of the affected limb. The syndrome has a remarkably negative effect on clients quality of life, unless treated properly.

Objective of the thesis was to find the latest evidence about physiotherapy for clients with CRPS. Based on the collected literature, an independent learning material package was created for physiotherapy students in Satakunta University of Applied Sciences. The research method of the thesis is action research, where the evidence was collected through a comprehensive literature search which was complemented with a manual hand search. The research question was: "what are the effective physiotherapy methods for treating clients with CRPS". Comprehensive literature search was conducted in September 2021. Original studies published in English, no older than 5 years, were included in the review. The product was created and piloted in January 2022 and the thesis was completed in February 2022 and presented in March 2022.

The best results in care of a client with CRPS seem to be reached with a multidisciplinary approach combining physiotherapy, and psychological- and pharmacological treatment modalities. Graded motor imagery and mirror therapy are the physiotherapy modalities that seem to give the best therapeutic effect for clients with CRPS. Having TENS as part of the physiotherapy session might increase ROM and decrease pain and oedema more than a physiotherapy session without TENS as part of the session.

Most studies researching the effectiveness of physiotherapy for clients with CRPS focus on clients with CRPS type I in the upper extremity. No studies researching the effectiveness of physiotherapy for clients with CRPS Type II or CRPS in the lower extremity were found as a result of this thesis process.

Key words
Complex Regional Pain Syndrome, Reflex Sympathetic Dystrophy, Physiotherapy

CONTENTS

LIST OF SYMBOLS AND TERMS

AIGS= Abnormal Impulse Generating Site

CGRP= Calcitonin-gene-related Peptide

CNS= Central Nervous System

CRPS= Complex Regional Pain Syndrome

EBP= Evidence-based Practice

GMI= Graded Motor Imagery

IASP= International Association for the Study of Pain

LANSS= The Leeds Assessment of Neuropathic Signs and Symptoms

NRS= Numerical Rating Scale

ROM= Range of Motion

RSD= Reflex Sympathetic Dystrophy

SAMK= Satakunta University of Applied Sciences

TENS= Transcutaneous Electrical Nerve Stimulation

VAS= Visual Analogy Scale

1 INTRODUCTION

Complex Regional Pain Syndrome (CRPS) is a neuroinflammatory syndrome. Its symptoms are: chronic pain that is unreasonably high to the time and decree of the injury, vascular changes, trophic changes, swelling, and functional impairment of the affected limb. Reflex Sympathetic Dystrophy Syndrome Association defines CRPS as: "a syndrome characterized by a continuing (spontaneous and/or evoked) regional pain that is seemingly disproportionate in time or degree to the usual course of pain after trauma or other lesion. The pain is regional (not in a specific nerve territory or dermatome) and usually has a distal predominance of abnormal sensory, motor, sudomotor, vasomotor/oedema and/or trophic findings. The syndrome follows variable progression over time." (Website of Reflex Sympathetic Dystrophy Syndrome Association 2021.)

Prevalence of CRPS yet remains unclear (Harno 2022). A population-based study in the USA noticed the prevalence of CRPS Type I to be 5.46 per 100,000 person years and the prevalence of symptomatic period was studied to be 20.57 per 100.000 person years (Sandroni, Benrud-Larson, McClelland & Low 2003, 199-201). In the Netherlands the prevalence of CRPS was studied to be higher compared with the American study with prevalence of 26.2 per 100,000 person years, women being 3-4 times more likely to get the syndrome (de Mos et al. 2007, 17).

CRPS has a remarkably negative affect to the clients life as chronic pain decreases clients functional abilities which leads to other personal losses in their lives. The clients experience to lose their integrity, intimacy, independency, identity, and individuality because of the syndrome which further on has a negative effect to participation to leisure time activities and ability to take care of oneself. The clients understanding of the syndrome and expectations of the treatment has an impact to the way they see their personal losses. Additionally, CRPS does not only affect the CRPS clients themselves, but their support partners are also affected by the condition. The

support partners feel like their own emotional needs are overlooked and the financial, physical, and emotional responsibilities are put onto them, when their partners CRPS symptoms exacerbate, which leads in conflicts in the relationships. (Raja, Buvanendran & Marcondes 2021, 4-5.)

Louw et.al. (2017) conducted a study, where they surveyed the beliefs and experiences of clients who have CRPS. Clients suffering from CRPS are studied to have confusing and conflicting beliefs about the syndrome and the knowledge they get is limited. All the clients in the study searched for information about CRPS from the internet, but less than half of the people felt it helped, while majority of the clients felt it either increased their concern or made them feel worse. Most clients reported having received the most information about the syndrome from their physiotherapist. The study concluded that patients suffering from CRPS is linked with lack of consensus by healthcare professionals and conflicting information about the condition. Current understanding of CRPS would benefit both the clients and the healthcare professionals. (Louw, Zimney, Cox, O'Hotto & Wassinger 2017, 1,5,6,8.)

The thesis was ordered by Satakunta University of Applied Sciences (SAMK), Degree Program in Physiotherapy. The thesis aimed in creating an independent learning material package for SAMK physiotherapy students about physiotherapy for clients with CRPS. The learning material provides the students some basic information about CRPS and the latest evidence about physiotherapy methods that can be used as part of the treatment for clients who have CRPS. The learning material was created with H5P, which is a plugin for Moodle. Moodle is an online learning environment which is used by SAMK. The independent learning material package will be used as teaching material for physiotherapy students and the material will be based in Moodle.

2 AIM AND OBJECTIVES

Objective of this thesis is to collect the latest evidence about physiotherapy for clients with Complex Regional Pain Syndrome (CRPS) through a comprehensive literature

search and find an answer to the research question: “what are the effective physiotherapy methods for treating clients with CRPS”. Aim is to create an individual learning material package about the topic based on the literature. The material will be used in the future as teaching material for physiotherapy students in Satakunta University of Applied Sciences (SAMK).

3 COMPLEX REGIONAL PAIN SYNDROME

CRPS can be divided into 3 subtypes: CRPS Type I, previously known as Reflex Sympathetic Dystrophy (RSD), CRPS Type II, previously known as causalgia, and CRPS-NOS (not otherwise specified). CRPS Type I is diagnosed when the diagnostic criteria are met, but there is no detectable nerve lesion. CRPS Type II is identical with Type I, but with an identifiable nerve lesion. The third subtype CRPS-NOS is diagnosed when there is no better explanation for the symptoms. (Harden et al. 2013, 184-185.)

3.1 Diagnostic criteria

Over time diagnosing CRPS has been chaotic due to variety of symptoms of the syndrome, and lack of consensus about standardized nosology and diagnostic criteria. The first attempt of creating diagnostic criteria for CRPS was in about 1850th century and it was based on anecdotal clinical signs and symptoms that were taken from experience. The recent attempts to formally define the syndrome were done in consensus workshops in 1988 in Schloss Rettershof conference and a more precise one in Orlando conference in 1994. The diagnostic criteria made in Orlando aimed in scientifically valid diagnostic criteria that is sensitive, inclusive and broad. The criteria was accepted by Committee for Classification of Chronic Pain of the International Association for the Study of Pain (IASP). However, the criteria was found to be too sensitive and to lead to over diagnosis. Therefore, new criteria was

created in Budapest by an international consensus group of experts in 2004, and it was accepted by IASP. The new criteria was named as Budapest criteria. Harden et. al. 2013, 181-184.)

Diagnosing CRPS according to Budapest criteria is based on clinical signs and symptoms. The criteria consists of four categories from which the clinical signs must be present. The first category is continuing pain which is not proportionate to the time and degree of the insisting event. The categories 2 and 3 have been divided into four smaller subcategories in which the clinical symptoms are categorised. These categories describe the sensory, vasomotor, sudomotor/oedema, and motor/trophic findings. The category 2 describes the client reported symptoms and the client must report at least one symptom in three of the four subcategories. The category 3 describes the signs and symptoms that are present at the time of evaluation and the client must present at least one sign in two or more of the subcategories. The fourth category states that there is no better explanation for the symptoms. The Budapest criteria is collected to Table 1. (Harden et. al. 2013, 185.)

Table 1. Budapest criteria for diagnosis of CRPS (Harden et.al. 2013, 185).

Budapest clinical diagnostic criteria for CRPS
1. Continuing pain, which is disproportionate to any inciting event
2. Must report at least one symptom in three of the four following categories: - *Sensory:* reports of hyperesthesia and/or allodynia - *Vasomotor:* reports of temperature asymmetry and/or skin colour changes and/or skin colour asymmetry - *Sudomotor/oedema:* reports of oedema and/or sweating changes and/or sweating asymmetry - *Motor/trophic:* reports of decreased ROM and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nails, skin)
3. Must display at least one sign at the time of evaluation in two or more of the following categories: - *Sensory:* evidence of hyperalgesia (to pinprick) and/or allodynia (to light touch and/or deep somatic pressure and/or joint movement)

- *Vasomotor:* evidence of temperature asymmetry and/or skin colour changes and/or skin colour asymmetry - *Sudomotor/oedema:* reports of oedema and/or sweating changes and/or sweating asymmetry - *Motor/trophic:* evidence of decreased ROM and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nails, skin
4. There is no other diagnosis that better explains the signs and symptoms

3.2 Clinical symptoms

Clinical signs and symptoms of CRPS are pain joint with sensory (allodynia and hyperesthesia), vasomotor, trophic, and motor abnormalities (Ott & Maihöfner 2018, 5; Sandeep 2011).

Clients with CRPS can experience pain as spontaneous or evoked. Spontaneous pain is often described as burning, stabbing or penetrating, or dragging. On average the pain is rated as 5 on average in numerical rating scale (NRS). Location of the pain is mostly in deep structures, but about 30% of the clients repost to feel the pain in superficial structures. Rarely the client cannot localize the pain. Almost all clients with CRPS experience dynamic pain that is evoked in most cases by movement of the limb. Dynamic pain is rated as 6 NRS on average and it is described as burning, stabbing or penetrating, dragging, pressing, throbbing, or constricting. The levels of pain are often fluctuating. Pain can be increased by temperature (hot or cold), light touch, movement, physical effort, during night, and orthostasis. (Ott & Maihöfner 2018,13-14.)

Autonomic and trophic signs are a typical feature of CRPS. These signs include changes in skin colour, abnormal growth of hair and nails, oedema and swelling, and differences in skin temperature. The skin colour may become pale, blueish, or red. However, not all the clients with CRPS get changes in skin colour. Hair and nails may grow faster or slower compared with the healthy limb. Most clients, about 70%, have swelling or oedema in the affected limb. Sweating alterations can be present as decreased or increased sweating, but not all the clients have altered sweating.

However, the listed signs and symptoms are not present in all the clients with CRPS. (Ott & Maihöfner 2018, 14.)

Motoric signs which are typically seen in clients with CRPS are decreased active range of motion, degreased muscle strength either in grip strength or standing on tip toes, dystonia, movement initiation disorder, tremor, and increased or decreased tendon reflexes. Typical sensory signs that are present in clients with CRPS are altered sensitivity to pinprick, altered sensitivity to light touch, dynamic mechanical allodynia, and spontaneous dysesthesia. Not all the clients with CRPS present all the listed signs or symptoms. (Ott & Maihöfner 2018, 14-15.)

Allodynia is a term for a condition where pain emerges from stimulus that normally would not aggravate pain. Hyperalgesia means that the pain is felt more intense that the stimulus would normally cause. Hyperesthesia means sensitivity to stimulation has increased, for example to touch or temperature with or without pain. Allodynia and hyperalgesia are both included in hyperesthesia. Dysesthesia is a term for unpleasant atypical sensation which can be elicited or spontaneous. Dysesthesia is a special case for hyperalgesia and allodynia. (Website of IASP 2021.)

3.3 Progression and prognosis

Progression of CRPS has been divided into three stages based on the duration of the symptoms. However, the disease process is individual and not all the clients go through all the stages. At stage I (acute stage) the client usually has pain and sensory abnormalities like hyperalgesia and allodynia, and vasomotor dysfunction. Also changes in sweating and oedema are present at this stage. Stage I usually lasts one to three months. At stage II (dystrophic stage) the symptoms keep progressing: pain intensifies, sensory abnormalities become more apparent, more evidence of vasomotor dysfunction, and clear motor and trophic changes develop. Stage II usually lasts for three to six months. Stage III (atrophic stage) the pain and sensory disturbances worsen, vasomotor disturbances continue to exacerbate, and motor and trophic chances are significantly improving. Stage III usually lasts for 9 to 18 months. (Sandeep 2011.)

Most of the times CRPS is initiated by a minor or moderate tissue injury, like a fracture. In the beginning the affected limb is typically painful, swollen, red, and warm. There are also changes in sweating and changes in hair and nail growth, and muscle weakness. Also, allodynia and hyperalgesia are often present. When the syndrome progresses, the pain doesn't decrease but spreads. Some clients voluntary motor control decreases. After months when the syndrome progresses often the previously warm limb becomes cold. The client might develop myoclonus, tremor, and dystonia. Moving the affected limb worsens the symptoms. As time goes on the clinical symptoms spread to the proximal direction and may even appear to the contralateral limb. (Marinus et al. 2011, 637.)

An American population-based study found the duration of the symptomatic period to range from 1 to 60 months with the median symptomatic period being 7 months. Duration is not affected by gender. 74% of the individuals with CRPS heal from the syndrome. (Sandroni et al. 2003, 201) About 15% of patients with CRPS experience physical dysfunction and persistent pain 5 years after the beginning of the symptoms which affects negatively to their ability to work and function (Turner-Stokes & Goebbel 2011, 596).

3.4 Pathophysiology

There are three pathophysiological main mechanisms behind CRPS which are abnormal inflammation mechanisms, vasomotor dysfunction, and maladaptive neuroplasticity. These elements are changing individually which explains the variety of individual clinical symptoms. (Harno 2016; Marinus et al. 2011, 637.)

3.4.1 Neurogenic inflammation

Neurogenic inflammation, which is seen as oedema, increased skin temperature, and redness, is caused by neuropeptides (substance P and calcitonin-gene-related peptide (CGRP)), as they cause vasodilation and extravasation of proteins to the tissue. The inflammatory changes that arise after trauma in CRPS are facilitated by substance P

and CGRP and the levels of these neuropeptides are higher in clients with CRPS compared with healthy individuals. Clients with CRPS also have altered cytokine balance which is linked with mechanical hyperalgesia. As mechanical hyperalgesia is a symbol for central sensitization, which is a process where activity of neurons in the spinal cord has increased, inflammatory cytokines are most likely acting locally in the limb and in the spinal cord, probably due to sensitization of secondary nociceptive neurons or due to glial-neuronal interaction. (Marinus et al. 2011,640-641.)

3.4.2 Vasomotor dysfunction

Activity of vasomotor neurons changes when CRPS progresses, which causes the temperature changes of the affected limb between hot and cold compared with the healthy limb. Typically, clients at the acute stage of CRPS have a higher skin perfusion value compared with the contralateral limb which causes the warmer skin temperature in the affected limb. This is caused by low activation of vasoconstrictor neurons and lower values of norepinephrine concentrate in the venous flow above the painful area. At approximately 15 months the affected limb is either warmer or colder compared to the healthy limb, depending on the sympathetic activity. When CRPS progresses, typically at 28 months on average, the perfusion and temperature of the affected limb is lower although, the norepinephrine concentrations are also lower on the effected side at this stage. Therefore, it is suggested that CRPS is linked with inflammatory vasodilation and inhibition of cutaneous sympathetic vasoconstrictor neurons, leading to warmer skin temperature at the acute stage. It is thought that the impairment of the thermoregulatory system is caused by functional changes in the brain, brainstem, or spinal cord. Therefore, it is thought that central disturbances in the efferent sympathetic flow causes the symptoms in the acute stage, and disturbance in the neurovascular transmission and hyperactivity of blood vessels to circulate catecholamines cause the symptoms in the chronic phase. However, it should be remembered that not all the clients follow the typical progression of temperature changes as the CRPS progresses, some clients have the affected limb cooler compared with the healthy one from the beginning. (Marinus et al. 2011, 641-642.)

3.4.3 Neuroplasticity

Neuroplasticity is a term that describes the nervous systems ability to change its activity in response to extrinsic or intrinsic stimulus by re-organizing its connections, structure, or functions. An important function of a neuron is its ability to adjust the efficacy and strength of synaptic transmission through a variety of activity-dependent mechanisms, which is called synaptic plasticity. Synaptic plasticity is part of recovering from brain lesion, brain development, learning and memory, and sensorial training. How synaptic plasticity moulds brain physiology and morphology is still not fully understood despite of various studies behind the mechanism of that. (Mateos-Aparicio & Rodrigues-Moreno 2019, 1.)

Neuroplasticity has been demonstrated in brain images in clients with CRPS in early and late stage. The images have shown structural and functional changes and sensorimotor integration at the early and late stages of CRPS. Clients with the early stage CRPS showed reduced volume of grey matter and reduced perfusion in those areas of the brain that associate with the somatosensory cortex, spatial body perception, and the limbic system. Clients with late stage CRPS showed no changes in the volume of grey matter, but the grey matter volume in the areas that process pain was negatively correlated with average pain levels, which is thought to be caused by ongoing pain. Additionally, the late stage CRPS clients showed increased perfusion in the motor cortex. Also, connectivity to sensorimotor cortex revealed disruptions in areas associated with planning and motor control, which suggests there is impairment in the higher-order motor control. (Shokouhi et.al. 2018, 146.)

3.4.4 Central Nervous Systems role in CRPS

Alterations in the central nervous system (CNS) are thought to be the basic mechanisms behind CRPS. However, it is not clear whether the abnormalities are in the disease or whether they have developed due to pain. Not pain-related impairment in muscle strength in all the muscles of the affected extremity, oedema, and severance of peripheral nerves are thought to be caused by centrally mediated impulse abnormality in the motor neurone pool. Patient-reported neglect-like symptoms are the

cause of severe motor dysfunctions. Increased physiological tremor due to changes in CNS is reported in approximately 50% of the patients. Weakened integration of sensory and visual afferent inputs to the parietal cortex are thought to be the cause of motor defects. (Wasner, Schattschneider, Binder & Baron 2003, 66-67.)

The symptoms of CNS can also cause weakness in movement and strength of the affected limb. CRPS is often characterized with a neglect symptom and perceptual disorder of the affected limb. Changes in the brain at the area of the affected limb have been detected in brain imaging studies. Sometimes the changes are seen on both sides of the brain cortex and CRPS can sometimes spread to the previously healthy opposite side limb. (Harno 2016)

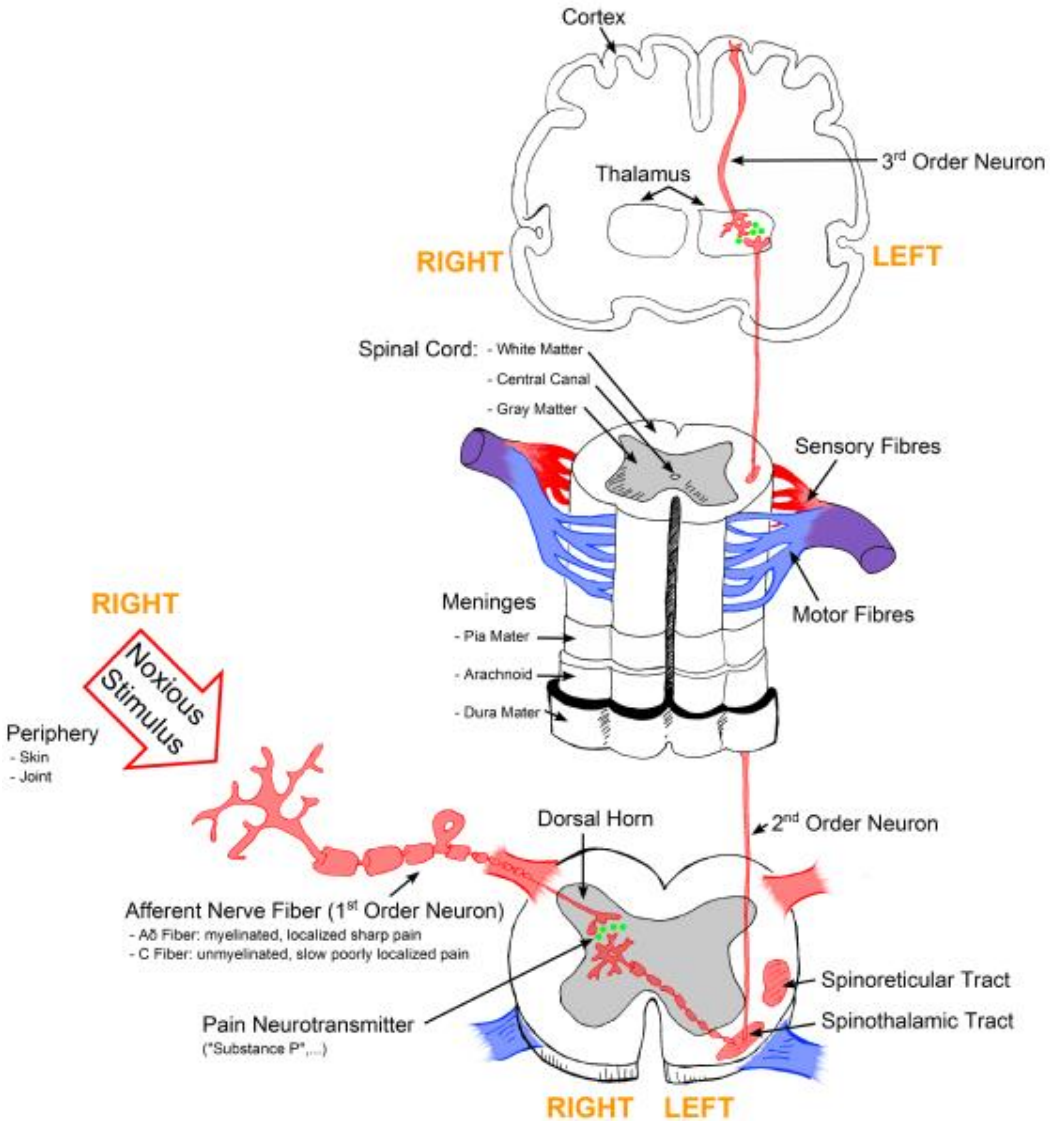
3.4.5 Pain mechanism in CRPS

International Association for the Study of Pain (IASP) defines pain as: "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage". Pain cannot be explained by activity of pain sensing neurons only as pain and nociception are a separate phenomenon. Pain is a subjective experience that is affected by social, biological, and psychological factors. Individuals learn the idea of pain throughout their lifetime based on their life experiences. Even though the role of pain often changes depending on the context, it might affect negatively on individuals' function and psychological and social well-being. (Website of IASP 2021)

The neural process that signals noxious stimuli is called nociception. A nociceptive neuron is a central or peripheral high-threshold sensory receptor of the somatosensory nervous system that is able to transduce and encode noxious stimuli. Nociceptive pain refers to pain that is felt due to activation of nociceptors because of actual or potential damage to non-neural tissue. Nociceptive stimulus is an actually or potentially tissue-damaging event transduced and encoded by nociceptors. (Website of IASP 2021)

The route for potentially pain causing impulses start from the periphery and end to the brain (see picture 1). First a noxious stimulus in the periphery activates nociceptors

which are free nerve endings. C-fibres are first order neurones. They are thin and slow nerve fibres that transfer pain or thermal sensation to the dorsal horn of spinal cord. There the signals synapse with WDR-neuron, which is a second order neuron. WDR-neuron transfers the information along spinothalamic tract onwards to thalamus which spreads the information to different parts of the brain. The brain creates an understanding from the information the stimulus sent. The prefrontal cortex processes the information and decides whether the situation is dangerous. If the information is a sign of a threat, the limbic system gets activated which causes stress reaction. Other parts in the brain activate as well, like cerebellum, sensory cortex, anterior cingulate cortex, insula, and basal ganglia. (Luomajoki 2020, 39-42.)



Picture 1. The anatomical pathway of pain sensation (Website of Wikimedia Commons 2021).

Nociceptive pain can be caused by mechanic, ischemic, and inflammatory stimulus. The first stage is called cellular stage where the injured cells release inflammatory mediators, the most important one being prostaglandin. In the second stage, neurogenic stage, the inflammatory mediators activate the C-fibre. C-fibre secretes substance P to the tissue which leads in vasodilation and swelling. Bloodstream transports to the injured area other inflammatory markers, for example histamine and serotonin. All these markers together activate some so-called sleeping nociceptors, which are nerve endings, that originally were not taking part to the inflammation. This leads to the tissue becoming more acidic, to which nociceptors are reacting to. (Luomajoki 2020, 53)

Neuropathic pain refers to pain that that is triggered by a lesion or a disease of a somatosensory nervous system. It is a clinical description of the symptom which inquires a disease or a verifiable lesion that fulfils the neurological diagnostic criteria. Term somatosensory refers to information about the body itself, including visceral organs, rather than information from the external world, like hearing and vision. Peripheral neuropathic pain refers to pain that is caused by a disease or a lesion of the peripheral somatosensory system. (Website of IASP 2021)

In order to the nerves to cause pain, they must be injured. Nerve lesion is linked to neuroinflammation and the immunological reaction that it causes. When a nerve gets injured, the area gets filled with cytokines that causes a local inflammatory reaction. This inflammatory reaction spreads along myeline to proximal, and possibly also to distal direction. In a peripheral nerve the pain itself is caused by physiological ion channel AIGS (Abnormal Impulse Generating Site). In a nerve injury its wall, axolemma, and its ion channels break, which causes conduction errors of the nerve signals in the ion channels. In a nerve lesion, physiological ion channels and membrane receptors may form. When these are activated, they may cause abnormal and painful impulses. In addition to the pain, neuropathic pain is combined with a neurological findings like muscle weakness, sensory findings, or decrease in the speed of nerve signal studied in ENMG. If these previously mentioned findings are not present, but the pain is neurogenic in nature (burning, radiating, intense pain), the pain can be thought to be neuropathic. (Luomajoki 2020, 56.)

Sensitization means increased sensitivity of nociceptive neurons compared with their normal input and/or recruitment of a response to normally subthreshold inputs. Central sensitization refers to increased responsiveness of nociceptive neurons in the central nervous system to their normal or subthreshold afferent input. Peripheral sensitization refers to increased responsiveness and reduced threshold of nociceptive neurons in the periphery to the stimulation of their receptive fields. (Website of IASP 2021)

Even if the function of sympathetic nervous system was shut down, the pain would still remain for the clients with CRPS which refers to the implication of Central Nervous System (CNS) in the mechanism of pain regulation. Chronic pain causes structural and functional changes in the CNS causing the central sensitization of the pain sensing nerves. Central sensitization causes hyperalgesia, allodynia, and the pain area to spread outside the original area of tissue damage. (Harno 2016)

Central and peripheral sensitization are thought to have caused the spontaneous pain and different forms of hyperalgesia of the affected extremity. Hyperalgesia and hemisensory impairment, which spreads over the affected area with spontaneous pain has been elicited in a clinical and quantitative testing of the nociceptive system, which suggests changes in the central afferent processing. Additionally, it is suggested that prefrontal networks are involved in sympathetically maintained pain in CRPS patients. Hemisensory impairment and sympathetically maintained pain are all thought to be caused by different disturbances in the CNS. (Wasner et al. 2003, 66-67.)

3.5 Risk factors

Two population-based studies that were detecting the prevalence of CRPS and the factors affecting on getting the syndrome were found (see table 2). On an American population-based study female sex was found to be a risk factor for developing CRPS as 80% of the clients with CRPS are female. The age for onset of symptoms in the study was between 15 and 86 years, mean age being 46.9 and median age being 46. Sex does not affect the onset age of developing the syndrome. Upper limb is twice as often affected as lower limb without any side predominance. Most common cause for developing the syndrome is fractures in 46% of the cases. Sprains are the second most

common cause with prevalence of 12% of the cases. In the rest of the 42% of the cases CRPS was caused by other various kind of injuries like stroke, contusion and crush but their prevalence rate was not informed. (Sandroni et at. 2003, 201-202.)

In a Dutch population-based study fractures were also found to be the most common cause for developing CRPS with a rate of 44%. Sprains were the second most common cause with a ratio of 17.6% and surgery was the third common with 12.2%. Tendon injuries caused 5.5% of the cases, other factors 8.8% of the cases and 1,3% of the cases the cause is unknown. Mean age of the onset for symptoms is 52 years and 77.3% of the clients were female. Upper extremity was affected in 59.2% of the cases and lower extremity in 39,1% of the cases without differences between the left and the right side. (de Mos et al. 2007, 16-17.)

Other risk factors for developing CRPS include: immobilization, pain on numeric rating scale (NRS) over 5/10 a week after fracture, ACE blockers that are used during the lesion, migraine, asthma, and musculoskeletal disorders like arthritis. There are CRPS- families and genetic factors may have a role in the development of CRPS, but the studies are still ongoing. (Harno 2022)

Table 2. Incidence rates of risk factors for developing CRPS.

Cause of CRPS	**Incidence Rate**	**Study**
Fractures	46% / 44%	Sandroni et.al. 2003 / de Mos et.al. 2007
Sprains	12% / 17,6%	Sandroni et.al. 2003 / de Mos et.al. 2007
Surgery	12.2%	de Mos et.al. 2007
Tendon injury	5.5%	de Mos et.al. 2007
Other factors	8.8%	de Mos et.al. 2007
Cause is unknown	1,3%	de Mos et.al. 2007

Majority of patients with CRPS experience psychological distress; anxiety and depression being the most common symptoms. However, psychological symptoms are not the cause of CRPS but instead the result. Numerous patients become overwhelmed by the pain and the rest of the symptoms and lack the coping skills for the situation.

Psychological support might prevent the patients from developing maladaptive coping skills. (Wasner et al. 2003, 67.)

Turner-Stokes & Goebbel (2011) also state that past psychological problems are not a risk factors for developing CRPS. However, psychosocial risk factors, that are known as yellow flags, may predict chronicity or the syndrome. These are for example previous negative experiences with health professionals, negative family influences, inappropriate beliefs despite education, passiveness in treatment sessions, lack of willingness to set goals, anxiety, depression, distress, overuse of appliances, excessive illness behaviour, poor coping strategies, and involvement in litigation. Psychological interventions and support might be needed to cope with the symptoms of CRPS. (Turner-Stokes & Goebel 2011, 596-597.)

4 PHYSIOTHERAPY IN CRPS

4.1 Multidisciplinary approach

Elomaa et al. studied the effects of a 12- week integrated, interdisciplinary outpatient therapy program for clients with chronic CRPS type I in the upper limb. The intervention consisted of pharmacological treatment, psychological modalities, and physiotherapy. Physiotherapy consisted of multiple treatment modalities that were: Graded Motor Imagery (GMI), individualized exercise program which consisted of strength training with weights and theraband, and group therapy sessions which focused on balance, postural control, neck and shoulder exercises, image exercises, body perception and desensitization. In addition, the clients were given a home-exercise program which focused on upper limb movements like grip, dexterity and selective finger exercises. The physiotherapy lasted for 7 weeks. The psychological interventions included cognitive and behavioural interventions and acceptance and commitment therapy in weekly 90-minute group sessions. In addition, the clients were encouraged to practice the learned pain management modalities for 20-30minutes a day at home. The psychological interventions lasted for 9 weeks. The planned

pharmacological treatment had to be stopped for all the participants due to side effects and the clients continued with their personal medication. As a result of the intervention the client-reported symptom count decreased significantly after the intervention. Motor and trophic changes reduced mean 19%, sensory symptoms -18%, vasomotor symptoms -14%, sweating and oedema symptoms -7%. The secondary outcomes that occurred were motor, pain and general outcome, that improved a little. The intervention significantly decreased pain in movement, but not in rest. The study participants quality of life did not improve after the intervention. The study concluded that patients with chronic CRPS type I should be rehabilitated with an interdisciplinary intervention. They concluded that because pain rarely decreases substantially or significantly, the effect of treatment modalities should be studied by other outcomes. (Elomaa et al. 2018, 1-7, 11.)

Taylor et.al. and Rand et.al. both state in their comprehensive literature reviews that treatment of CRPS should consist of a multidisciplinary approach that includes physiotherapy, occupational therapy, pharmacological treatments, and psychological interventions. Both reviews state that physiotherapy and occupational therapy play and important role in the treatment of CRPS. Various physiotherapeutic modalities have been studied for the treatment of CRPS, but Graded Motor Imagery (GMI) and mirror therapy seem to have the greatest therapeutic effect in the treatment of CRPS. Other modalities that have been studied that might have a positive outcome are therapeutic exercise that includes ROM and strengthening exercises. (Taylor et.al 2021, 8; Rand, Basu & Khalid 2019, 327.)

4.2 Clinical guidelines

The Finnish Current Care Guidelines for healthcare practitioners treating clients with pain highlight that pain is real despite its pathophysiology or aetiology. Good care of a client with pain is based on a functioning client-professional relationship. Good care of a chronic pain client is based on an on-going treatment relationship. There should be enough time reserved for the interview. In the meeting, the healthcare professional should ensure that the clients pain problem, goals, and views are understood. Facing a client with pain should be based on an empathetic approach. Treatment plan should be

done in collaboration with the client and both parties should engage in it. The clinical examination of the client should be done thoroughly, and the findings should be explained understandably. The individualized patient education should be part of every meeting and clients' activity, capability, responsibility, and a calm attitude towards pain should be supported. This current care guideline aims to improve safe and effective treatment and concerns mainly the most common long-term musculoskeletal pains, CRPS included, and the pharmacological and non-pharmacological treatment of them. (Website of Käypähoito :Current Care Guidelines 2021.)

The second edition of the UK guideline for Complex Regional Pain Syndrome in Adults for diagnosis, referral, and management of CRPS in primary and secondary care states that treatment approach of a client with CRPS should be interdisciplinary and cover four pillars which are: physical and vocational rehabilitation, psychological interventions, patient education to support self- management, and pain relief (see figure 1). To provide the best practice the physiotherapist should: recognize the clinical signs of CRPS and know the Budapest criteria, aim in early start of the treatment, give patient education about the syndrome, know where to refer the client for pain or CRPS specialized rehabilitation, and identify the non-resolving moderate or severe symptoms, and when possible, refer the client to a pain or CRPS specialized centre. (Goebel et al. 2018, 3-4, 12.)

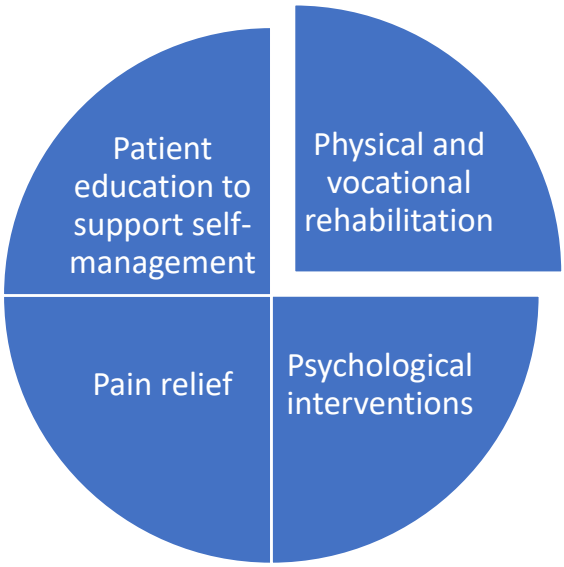


Figure 1. Four pillars of treatment (Modified from Goebel et al. 2018, 4).

To evaluate the CRPS symptoms as mild, the UK guideline states the clients should present a few signs of pain-related disability or stress, which would be managed adequately by either conventional or neuropathic drugs. Clients who have intense pain, disability or distress, should be referred to pain or CRPS specialized centre for multidisciplinary rehabilitation. To evaluate the CRPS symptoms as moderate or severe, the client should present moderate or severe symptoms, dystonia, no positive response to treatment within four weeks, or the symptoms get worse, or the improvements are not maintained in spite of ongoing treatment. (Goebel et al. 2018, 10.)

Physiotherapist should screen the presence of possible yellow flags (see table 3) the clients might have prior starting the treatment or that the client might develop during the treatment. Recognizing yellow flags might help the physiotherapist to understand the possible reason for poor treatment response. Presence of yellow flags might also predict chronicity of the syndrome. (Goebel et al. 2018, 11.)

Table 3. List of yellow flags (Modified from Goebel et al. 2018, 11).

Yellow Flags
• fear avoidance • negative family influences • inaccurate beliefs of the condition despite education • anxiety and depression • passivity in therapy sessions • distress • overuse of appliances • involvement in litigation • poor coping strategies • iatrogenic factors (e.g. negative experiences with health professionals in the past) • lack of willingness to set goals

The UK guideline for diagnosis, referral, and management of CRPS in primary and secondary care recommends two treatment pathways for physiotherapists. For choosing the correct pathway, the therapist should detect whether the symptoms the client has are mild or moderate to severe. If the symptoms are mild, the therapist should educate the client about the syndrome and start the physiotherapy treatment modalities from table 4. If the client is responding to the physiotherapy treatment positively within four weeks and the improvement is ongoing, treatment can be continued. If the physiotherapy treatment fails to respond within four weeks, the physiotherapist should refer the client to a pain of CRPS specialized rehabilitation centre that has an interdisciplinary approach. If the symptoms are moderate to severe, the client should be educated about the syndrome, physiotherapy treatment modalities from table 4 and table 5 should be started, and the client should be referred via medical doctor to a pain or CRPS specialized rehabilitation centre that has an interdisciplinary approach, where pain management programme is conducted. The UK guideline recommended therapy modalities for CRPS are collected in table 4 and table 5. (Goebel et al. 2018, 9.)

Table 4. Therapeutic approaches for "mild" CRPS (modified from Goebel et al. 2018, 12).

Therapeutic Approaches
• patient education and support • self-administered tactile and thermal desensitization • general exercises and strength exercises • functional activities • mirror and visual feedback • gait training to normalize gait • TENS • postural training • pacing, prioritising, and planning activities • goal setting • relaxation techniques • coping skills • hydrotherapy • sleep hygiene • strategies to control oedema

• vocational support • facilitating self-management of the condition • splinting (in acute CRPS for short term)

Table 5. CRPS specific therapy approaches (modified from Goebel et al. 2018, 12).

CRPS Specific Rehabilitation Techniques
• graded motor imagery • tactile discrimination • strategies to correct body perception disturbance, including touching, thinking and looking at the affected body part • mental visualisation to normalise altered size and for perception of the affected body part • management of CRPS- related dystonia • functional movement techniques to improve motor control and awareness of affected limb position • principles of stress loading • colflict allodynia re-education to reduce fear of physical contact with others

4.3 Graded Motor Imagery

GMI is a therapy method that consists of three stages: left/right discrimination, explicit motor imagery, and mirror therapy (see figure 2). In the left/right discrimination exercise the client aims to recognize the left or the right side of the painful body part from pictures. In the explicit motor imagery exercises the client imagines moving with the painful body part without actually moving it. When imagining movements, the client is activating the same areas in the brain as she would activate when actually moving the body part. Mirror neurons in the brain are firing when you imagine moving or watch someone else performing the movement. The third phase is mirror therapy,

which is a therapy method where the client puts the painful extremity behind a mirror and the healthy limb in the front. Now when moving the healthy limb, the brain thinks the healthy limb that is seen in the mirror is the painful one. (Website of Graded Motor Imagery 2022)

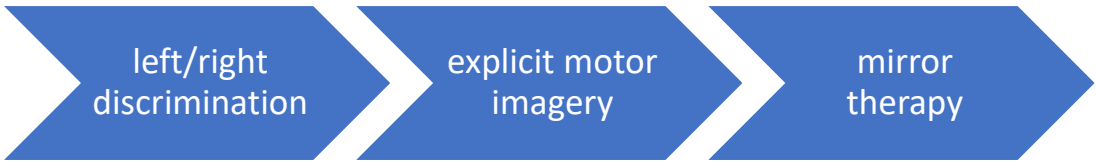


Figure 2. Three stages of GMI.

4.4 Physiotherapy program

Short term effects of a physiotherapy program for clients with CRPS type I after distal radius fracture was studied in 2019 in Chile. The study was executed with 54 patients over 60 years old that had CRPS type I after distal radius fracture. For 6 weeks they received physiotherapy twice a week for 60 minutes at a time. The physiotherapy consisted of hydrotherapy, manual therapy, and motor skill exercises. As the outcome of the intervention pain decreased significantly and wrist-hand function and upper extremity function increased significantly, but the increase was thought to be clinically minimally important. After intervention grip strength improved 14%, but the increase was not big enough to be statistically significantly changes. Therefore, the study concludes that 6weeks physiotherapy program for clients over 60 years old with CRPS type I after distal radius fracture improves functionality and decreases pain in short term. (Gutierrez-Espinoza, Tabach-Apraiz & Oyanadel-Maldonado 2019, 403-406.)

For evaluation of the starting point and for follow up the CRPS symptom count tool can be used (see table 6). Each finding is worth one point. A five-point change in the follow up can be thought to be a good result. The symptom count evaluation tool is made for evaluation of CRPS symptom count in the upper limb. (Harno 2022)

Table 6. CRPS symptom count tool (Modified from Website of Terveysportti 2022).

PATIENT REPORTED SYMPTOMS IN THE UPPER LIMB	**SYMPTOM**
	Pain
	Allodynia or Hyperalgesia
	Temperature difference compared to healthy limb
	Asymmetry in skin colour
	Asymmetry in sweating
	Asymmetry in swelling
	Trophic changes
	Weakness in muscle strength
FINDINGS AT THE TIME OF EXAMINATION	**SYMPTOM**
	Hyperalgesia to pinprick
	Allodynia
	Temperature difference over 1°C
	Asymmetry in skin colour
	Asymmetry in sweating (palpated)
	Asymmetry in swelling
	Trophic changes
	Weakness in muscle strength

4.5 Transcutaneous Electrical Nerve Stimulation (TENS)

Effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) on clients with CRPS type I in upper extremity was studied in a randomized, double-blinded, placebo-controlled prospective study in Antalya in 2016. The study group and control group had identical physiotherapy programs apart from study group receiving TENS and control group sham TENS. Other physiotherapy modalities that were part of the physiotherapy program were contrast bath, whirlpool bath, and exercise program. As

a result of the intervention, pain measured in VAS scale and Neuropathic pain scores decreased in both groups. However, pain in VAS scale decreased significantly more in the study group. The Leeds Assessment of Neuropathic Symptoms and Signs (LANSS) score decreased significantly in both groups, but the decrease was significantly greater in the study group. Volumetric oedema decreased in both groups after the treatment, but the decrease was significantly greater in the study group. Grip strength values increased in both groups after treatment similarly. ROM of the hand and wrist increased in some directions after the treatment in both groups, but the increase was significantly greater in the study group in some joints. (Bilgili et al 2016, 661,664-667.)

5 THE PRODUCT

5.1 The customer

Independent learning material about physiotherapy for clients with CRPS was ordered by SAMK Degree Program in Physiotherapy. The material would be used as teaching material as part of the course Physiotherapy in Pain Management. The content of the learning material was discussed with the customer in December 2020 and the author of the thesis was given free hands to create the material apart from a few requests that were to include basic knowledge about the syndrome and the physiotherapist role in the treatment while remembering the holistic approach. In addition, the customer requested that studying the material would take on average 30 minutes from the students. Before putting the product into use the customer was met once more to get the final feedback about the product to ensure the product responds to the customers expectations.

5.2 H5P and Moodle

The study material package was based in Moodle platform, which is an open-source online learning environment. Moodle is widely used as the platform for study material in the Finnish universities of applied sciences, also in SAMK. The material was created with H5P, which is a plugin for Moodle to create interactive material, tasks, and online content. As the independent learning material is only a part of the course Physiotherapy in Pain Management in the Degree Program in Physiotherapy and the material of that course locates in Moodle, it would be convenient for the users to have the independent learning material locating in the same platform. Therefore, Moodle was chosen as the location for the independent learning material.

5.3 Quality assurance of the product

5.3.1 Evidence-based practice

Evidence-based practice (EBP) combines three components: clinical expertise, the best scientific research evidence, and patient values and circumstances. When following the EBP method, the therapist will provide a good quality care for the client, that is based on science, lead with clinical expertise and directed by the clients' personal values and current life situation. (Fetters & Tilson 2012, 2.)

High-quality clinical research is conducted on clients in clinical settings. It is empirical in nature, meaning the research results are based on observation or experiment rather than theory. High-quality clinical research has been designed, executed, and reported in a way that the results can be trusted. One must evaluate the quality of research herself to determine whether the research results were reliable enough to let it affect the clinical decision making. (Herbert, Jamtvedt, Hagen & Mead 2011, 2.)

Clinical guideline is a collection of evidence from several different studies and based on the collected results, a recommendation for practice is done. Clinical guidelines include information about the management of the clinical condition which includes diagnosis, prognosis and effects of therapy and client experiences. Evidence-based

clinical guidelines are created from a combination of high-quality clinical researches and influenced by clinical experts and client experiences to formulate a reliable recommendation for practice. (Herbert et al. 2011, 135.)

Content of the learning material aims to follow the latest evidence, no older than 5 years. Clinical researches and clinical guidelines were included in the thesis. Finland doesn't currently have a clinical guideline specifically for CRPS, but they have a guideline for treating clients with pain, that includes CRPS. Therefore, the guideline was included in the thesis.

5.3.2 eAMK quality criteria

eAMK quality criteria (eAMK quality criteria 2017) for online courses states that the target group of the online course should be defined, and the product should consider them in the planning, making and during the implementation. Aims of the course should be defined in the course description. Content of the course, methods and technical and pedagogical solutions should support reaching the learning objectives. Aims and purpose of the tasks, schedule, estimated time and evaluation criteria should be defined clearly. In the tasks the student should be able to utilize different technological possibilities like video, sound, text, and pictures. Content of the course should be designed so that the student can connect it to previously learned things and she can implement the knowledge. The content should follow latest evidence and it should be reliable. References to the material should be available in the product. Guidance and feedback should be available during the online implementation. Layout and usability of the product should be guaranteed so that the font of the text remains the same throughout the course, content looks congruent, visual elements should support the content, and the course progression and structure should be clearly explained. Feedback should be collected from the students and the teacher after the implementation and the course should be developed based on the feedback. (Website of eAMK 2021)

The product follows parts of the eAMK:s quality criteria for the online implementations. All the criteria of the eAMK:s quality criteria was not met when

making this product because this learning material is only a part of a bigger course and therefore all the aspects of the criteria cannot be implemented in the product. The progression of the course, learning objectives, estimated time, and evaluation criteria are all instructed in the product and are made in collaboration with the responsible teacher of the Physiotherapy in Pain Management course. The learning material was made to allow the student to participate the course interactively. Interactivity is assured in the product by tests that will give you immediate feedback after accomplishing it. The material also included a video, pictures and tables to enhance learning. Content of the material was presented in order which allows the student to implement the previously learned knowledge to the new one. Layout of the product was designed to be congruent, and the font remains the same throughout the material to ensure a reader friendly outlook. References to the information given in the material was included in the material. Feedback was asked from the teacher of the course and from students that piloted the course.

5.3.3 Piloting the product

Usability of the product was tested with a piloting with physiotherapy students from SAMK. The feedback was collected with an anonymous online survey, created with e-survey. E-survey was chosen for collecting the feedback because it guarantees the participants anonymity and data safety. The responses were disposed after completing the piloting. The questionnaire had closed and open-ended questions. The questionnaire can be seen as APPENDIX 1. The number of responses was 4.

The feedback that was received from the piloting was primarily positive. All the participants found the information given in the material relevant to the topic and all the participants wrote that browsing the material was simple and easy. Exam questions were thought to be relevant by all the participants. One participant wrote: “Yes, helped to recap the info learned”. However, one participant thought the questions of the quiz could have been more difficult. Video and pictures were thought to enhance the learning, but one participant wished the text would have been split into smaller paragraphs. Based on the feedback, the length of the material was satisfactory, as studying the material took about 30 minutes on average from the students.

Some changes were done to the material based on the feedback from the piloting. Some spelling errors were corrected, and text was split into shorter paragraphs. The exam questions were also modified to be a little more difficult.

6 RESEARCH METHOD AND THESIS PROCESS

6.1 Action research and thesis process

Action research is a research method that aims in creating a product, for example a guidebook or a booklet. Phases of action research are action planning, action, observation, and reflection (see figure 3). After forming a cycle, the action continues with new cycles , where the actions of the previous cycle are reflected. Action research requires co-operation with different operators during different phases of the process which is seen as for example giving and receiving feedback, conversations, and evaluation. Action research has similar elements and processes as scientific research has in the process, but the methods are not action research followed as strictly as in the scientific research. (Salonen 2013, 5-6, 9,15-16.)

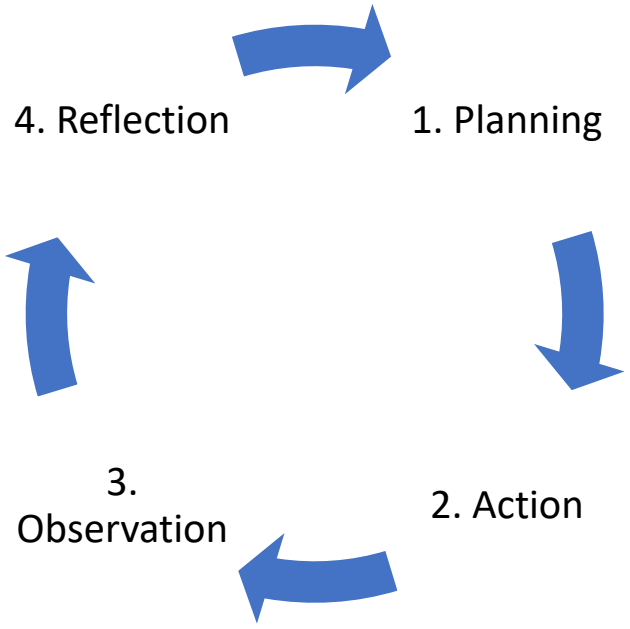


Figure 3. Phases of the action research cycle.

Action research was chosen as the research method of the thesis as the thesis aimed in creating an evidence-based product and the thesis process follows the cycles of an action research (see table 4). A thesis process usually forms one cycle, as did this one. Thesis process started in October 2020 when the topic for the thesis was chosen. The process continued with looking for knowledge about the topic and making a thesis plan that was accepted by the thesis supervisor. Research permit was applied for and given in December 2020. The process continued with contacting the customer of the product to inquire the expectations the customer has about the product. Between October 2020 and January 2022 literature regarding the topic was searched. The comprehensive literature search was done September 2021. Writing of the thesis was done between July 2021 and February 2022. The product was created in January 2022 and feedback from the customer was asked once the product was ready. Usability of the product was tested in a piloting in February 2022 with physiotherapy students from SAMK. Thesis was finished in February 2022 and presented in March 2022. The thesis process conducted the cycle of an action research once. The cycles of the thesis process and the schedule are demonstrated in table 7.

Table 7. The cycles of action research and the phases of this thesis process.

Cycle Phase	**Task**	**Time**
Planning	Choosing the topic	October 2020
Planning	Making a thesis plan	December 2020
Planning	Getting the thesis plan and research permit accepted	December 2020
Action	Contacting the customer	December 2020
Action	Searching for literature regarding the thesis topic	October 2020- January 2022
Action	Comprehensive literature search	September 16th 2021
Action	Creating the Product	January 2022
Action	Writing thesis	July 2021-February 2022

Observation	Contacting the customer for feedback	February 2022
Observation	Piloting the product with students	February 2022
Reflection	Reflecting the feedback from the customer and the piloting	February 2022
Action	Final adjustments to the product	February 2022
Action	Thesis presentation	March 2022

6.2 Comprehensive literature search

Comprehensive literature search is a general overview of literature about the topic without strict rules. In comprehensive literature review the choice of material is not limited by methodological rules and therefore the used material is comprehensive. The research questions are often more extensive compared with systematic reviews, but the researched phenomenon can still be described and categorized, if needed. (Salminen 2011, 6.)

For collecting literature about the topic, the author decided to make a comprehensive literature search to include the most resent and relevant literature to the thesis and the product. The comprehensive literature search was done 16th of September together with the SAMK librarian and the search terms and databases were chosen together. The database that was used for the literature search was PubMed. The literature that was included in the search was no older than 5 years. The search terms used were ("Complex Regional Pain Syndromes"[mesh] OR "Complex Regional Pain Syndromes"[tiab] OR crps[tiab]) AND (physiotherap*[tiab] OR “physical therap*”[tiab]). The research question to which the author was looking for an answer to was: “What are the effective physiotherapy methods for treating clients with CRPS?” For inclusion systematic reviews, RCT:s and clinical guidelines were prioritized. Only English literature was included.

The search created 58 results. 34 articles were excluded based on the heading, 9 articles were excluded based on the abstract, 6 articles were excluded because they were not open to access, and 4 articles were excluded based on the text. 5 articles were included in the process in the end. Table 8 illustrates the exclusion process of the comprehensive literature search. The literature search was complemented with a manual search to get sufficient amount of knowledge to the learning material. In the complementary manual search clinical diagnostic and treatment guidelines were looked at as they were not found in the literature search. The manual search resulted in 2 articles. Table 9 lists the articles that were included in the comprehensive literature search and the complementary manual search.

Table 8. The search words and the exclusion process of the comprehensive literature search.

Database	**Search Words**	**Exclusion Number and Criteria**	**Article Count**
PubMed	("Complex Regional Pain Syndromes" OR crps) AND (physiotherapy OR physiotherapist OR "physical therapy" OR "physical therapist")		58
		34 excluded based on heading	24
		6 excluded based on abstract	15
		4 excluded based on text	5 INCLUDED

Table 9. The articles of the comprehensive literature search and complementary manual search.

Search Method	**Article Name**	**Authors**
Comprehensive literature search	The Effectiveness of Transcutaneous Electrical Nerve Stimulation in the Management of Patients with Complex Regional Pain Syndrome: A Randomized, Double-blinded, Placebo-controlled Prospective Study	Bilgili et.al 2016

Comprehensive literature search	Physical Therapy in Patients with Complex Regional Pain Syndrome Type I After Distal Radius Fracture: A Case Series.	Gutierrez-Espinoza, Tabach-Apraiz & Oyanadel-Maldonado 2019
Comprehensive literature search	Complex Regional Pain Syndrome: A Comprehensive Review.	Taylor et.al 2021
Comprehensive literature search	Complex Regional Pain Syndrome: Current Diagnostic and Treatment Consideration	Rand, Basu & Khalid 2019
Comprehensive literature search	Symptom Reduction and Improved Function in Chronic CRPS Type I After 12-week Integrated, Interdisciplinary Therapy	Elomaa et.al. 2018
Complementary manual search	Pain. Current Care Guidelines.	Working group set by The Finnish Medical Society Duodecim, The Finnish Society of Anaesthesiologists
Complementary manual search	Complex regional pain syndrome in adults: UK guidelines for diagnosis, referral and management in primary and secondary care	Goebel, Barker, Turner-Stokes et al. 2018

7 DISCUSSION

Objective of this thesis was to find evidence about physiotherapy for clients with CRPS and find an answer to the research question: “What are the effective physiotherapy modalities for treating clients with CRPS?”. The comprehensive literature search resulted in 5 articles and the search was complemented with a manual search that resulted in 2 articles. The best results in client care are reached with a multidisciplinary approach (Taylor et.al 2021, 8; Rand, Basu & Khalid 2019, 327; Elomaa et.al. 2018, 1-7, 11). It seems, that GMI and mirror therapy have the best therapeutic effect when treating clients with CRPS (Taylor et al. 2021, 8; Rand et al.

2019, 327). Adding TENS to physiotherapy program seems to decrease pain in VAS-scale, increase ROM, decrease neuropathic signs and symptoms, and decrease oedema more compared with physiotherapy only (Bilgili et.al 2016, 661,664-667).

The independent learning material for physiotherapy students that was created as the result of this thesis, collected basic information about CRPS and the latest (no older than 5 years) evidence about the effective physiotherapy methods for clients with CRPS. The learning material will be used in SAMK as part of the course Physiotherapy in Pain Management in Degree Program in Physiotherapy. The comprehensive literature search didn't get any results about studies that consider CRPS Type II or CRPS in the lower limb, hence the studies that were used in this thesis are based on studies about CRPS Type I in the upper limb. Because of this, no straight conclusions can be made about the effectiveness of these physiotherapy methods for CRPS Type II or CRPS in the lower extremity. As the literature search only resulted in 5 articles and the studies that were included were small in sample size and knowing that the nature of CRPS is fluctuating and follows an individual progression, the effects/results of the physiotherapy methods that were collected should be taken with considerations. Also, the studies included in the thesis did not evaluate the long-term outcomes of the treatments. Because of the ongoing research around CRPS and new evidence constantly being published, the knowledge in this thesis and the product will not last time therefore, the information in the product should be reviewed in regular basis. Generally, effects of different physiotherapy methods for clients with CRPS should be studied more in randomized controlled trials to evaluate what are the best physiotherapy methods for treating clients with CRPS.

This thesis focuses mainly on the biological and physiotherapeutic aspect of CRPS, main focus being the physiotherapists role as part of a multidisciplinary team. Psychological aspect of the syndrome is mentioned but not further discussed. With the current understanding of humans being a biopsychosocial complex, the care should also take the whole complex into consideration. The guidelines used in this thesis all recommend pharmacological, physiotherapeutic, and psychological interventions combined but performed by a different professional. Therefore, the effectiveness of psychosomatic physiotherapy methods could be studied in the future to see if physiotherapists can also contribute to the psychological aspect of the treatment.

The whole thesis process was a valuable learning experiment for the author. The topic of the thesis was chosen due to the authors personal interest to the concept of pain and the syndrome. Action research as the research method was a valuable learning experience as action research follows the same phases and cycles as project or development works do. Experience of working with different stakeholders when developing or creating a product will be beneficial in the future work life.

The author decided to conduct a comprehensive literature search as part of the thesis process as she wanted to practice the literature review process. The comprehensive literature search thought how to search for literature from different databases, how to choose the search terms, and how to critically evaluate studies. Experience from literature review process will be useful in the future studies.

The author of this thesis declares there were no ethical issues when conducting this thesis. Research permit was applied from SAMK. Students participating in the piloting of the learning material were informed that they participate in the study voluntarily. Their answers were collected via e-form, which guarantees the anonymity of the participants, and their feedback cannot be connected to them. The collected feedback was disposed after completing the thesis process.

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APPENDIX 1

Experiences from independent learning material about physiotherapy for clients with CRPS

The purpose of this survey is to collect feedback from the independent learning material about physiotherapy for clients with Complex Regional Pain Syndrome. The feedback is used to improve the material for future use. By giving feedback about the learning material, you are giving your permission to participate the study. Filling the survey is completely voluntairy and anonymous. No personal data is collected from you and your answers cannot be connected to you.

Choose the correct answer

How long did it take you to study the material? *

- [ ] 1-15min
- [ ] 16-30min
- [ ] 31-45min
- [ ] 46-60min
- [ ] over 60min

Open questions

Did you have any challenges navigating the interactive learning material? If so, what were the challenges?

Was the material relevant to the topic?

Were the exam questions relevant to the material given?

Was there something in the material that was enhancing your learning or challenging it?

Do you have any other feedback considering the learning material that you would like to share?

Tietojen lähetys

Tallenna