Constant, burning pain coupled with trophic changes after an injury has been puzzling since it was first documented during the American Civil War.1 Over the years, these symptoms have been known as “causalgia” and “sympathetic reflex dystrophy”.1 Today, it is now recognized as Complex Regional Pain Syndrome (CRPS). It is a neurologic pain syndrome that involves the peripheral and central nervous systems where it largely affects the sensory, motor, and autonomic systems.1,2  CRPS is characterized by persistent, extreme pain in the lower and/or upper extremity(s) that ensues spontaneously or following minor trauma.3

Complex Regional Pain Syndrome has two subtypes. Type I is the most common and develops without apparent injury to a nerve, whereas Type II occurs after a confirmed nerve injury.1,2 Events such as fractures, sprains/strains, soft tissue injury (i.e. burns, cuts, or bruises), immobilization, or medical procedures (i.e. needle stick) are common triggers.1 Despite the two types, the presentation and course of the syndrome is similar.9 CRPS can be further characterized into stages to determine the time of onset. It begins with the acute stage, which involves abnormal pain perception and sensory function, edema, sudomotor, and vasomotor dysfunction.1 After three to six months, the acute stage transitions into the dystrophic stage. In this stage, sensory symptoms continue, motor function becomes altered, and trophic changes develop.1 The final stage is the atrophic stage where the motor and trophic changes predominant.1

The diagnosis of CRPS can be a long, difficult process. There are no specific tests to confirm CRPS, as the diagnosis is based on the patient’s clinical presentation and symptoms. Therefore, other diseases should first be ruled out. Potential diagnoses are: arthritis syndromes, Lyme disease, muscle diseases, clots, compartment syndrome, and disease associated polyneuropathies (i.e. diabetes).2,4 To assist the diagnosis of CRPS, the International Association for the Study of Pain (IASP) developed diagnostic criteria.1 First, the patient must experience continuous pain that is disproportionate to the provoking event.1 The patient must report at least one symptom in three of the four categories and exhibit at least one sign at the time of evaluation in two out of the four categories—1) hyperalgesia, 2) skin temperature asymmetry or skin color changes, 3) asymmetrical sweating or edema, and 4) decreased range of motion, dystonia, tremors, weakness, trophic changes of hair and/or nails.1 Finally, when other potential diagnoses are ruled out then CRPS may be the appropriate diagnosis.1

Some individuals may be more susceptible to develop CRPS due to genetics, personality, being of the female gender, and a history of stressful life events.1 The prognosis of CRPS varies depending on the age and the timing of treatment. The majority of children and teenagers have a good recovery where symptoms may improve or completely dissipate. Approximately 80% of all patients with CRPS Type I recover completely within 18 months of its onset.5 But, for some the pain remains and intensifies over time, leaving the person disabled.2 Many studies have been conducted to gain a better understanding of the pathophysiology of CRPS, but many aspects remain unanswered.1 The following sections will discuss the known somatosensory deficits caused by CRPS and the physical therapy interventions available.

*Sensory Dysfunction*: The primary sensory dysfunctions are pain, hyperalgesia, and allodynia. Pain is often described as burning, tearing, stinging, pins and needles, or squeezing.1,2 These sensations are felt deep inside the tissues, and are usually distributed in a glove or stocking like pattern.1 The pain can be exacerbated with changes in emotional status (i.e. excited, anxious, depressed, stressed) and at nighttime.1,5 Next, normal sensations are heightened and misinterpreted as painful stimuli.5 Patients experience an increased sensitivity to painful stimuli (hyperalgeisa) and perceive mechanical light touch as painful (allodynia).1,4 Conversely, mechanical and noxious sensory stimuli may become diminished as in reduced normal sensation (hypesthesia), decreased sensitivity to pain (hypalgesia) and touch, but is still identified as pain (anesthesia dolorosa ).1,5

*Motor Dysfunction*: Many patients experience muscle weakness in the affected limb. In the acute stages, increased edema contributes to decreased range of motion.4 As CRPS progresses, active range of motion becomes restricted; however, passive range of motion is still possible. Patients commonly guard the limb which contributes to further decreased range of motion and contracture. The affected limb is often reported as “foreign” as patients display “neglect like” behavior that transitions into “learned disuse”.4 Other motor symptoms involve decreased hand dexterity, difficulty completing complex movements, and tremors. CRPS type II is also associated with dystonia and myoclonus.1,4 In some cases, patients are left with complete paralysis and loss of function.7

*Autonomic Dysfunction*: Patients commonly display signs of swelling and changes in the color and temperature of the skin on the affect limb(s) due to abnormal microcirculation and subsequent nerve damage.2 Initially, the skin is often red, but turns more pale over time. A skin temperature change by 1o C between the affected and unaffected limb is considered significant.1 Hyperhidrosis or abnormal sweating is another common feature of CRPS.1 Additionally, the skin, hair, and nails undergo noticeable growth because of trophic changes.2

These symptoms can be owed to significant reorganization of the primary somatosensory cortex.1,6 These changes have been observed in patients with CRPS under functional imaging studies where the representation of the affected limb was found to be condensed and shifted.1,4 These changes disrupt the normal body schema.6 The degree of reorganization is positively correlated to the severity of pain and mechanical hyperalgesia experienced by the pateint.1,4 Additionally, altered neuronal activity has been noted in bilateral primary motor cortices under transcranial magnetic stimulation.1,6 This bilateral extension may be a possible explanation as to how CRPS can involve additional limbs. The somatosensory cortex was seen to revert back to normal after successful treatment.1 Therefore, it is critical to begin treatment immediately after the CRPS diagnosis so that impaired functional mobility can be regained and prevented.1

Physical therapy is highly recommended as the primary treatment for CRPS.10 However, there is limited evidence that indicates the treatment of choice. Physical therapy can address the impairments imposed by CRPS by increasing blood flow to the muscles through movement, desensitization and pain reduction, improve mobility, increase flexibility and strength, preserve and gain movement.2,5 Originally, treatment for CRPS was largely pain focused; however, this approach was counterproductive as pain inhibited any progress.7 Physical therapy should not just address the patient’s symptoms, but rather concentrate on targeting cortical processes and reorganization. Treatment approaches of pain exposure physical therapy (PEPT), visual input, mirror therapy, and mental imagery processing appear to be promising methods to treat CRPS.

Pain exposure physical therapy (PEPT) is a progressive loading exercise program that focuses on restoring function by managing pain avoidance behaviors, neglecting the pain, and increasing self-confidence.7,8 Studies have been conducted to determine if this method is safe and effective in patients with CRPS. Ek et al7 examined the PEPT approach in patients with chronic CRPS Type I. The subjects received treatment 1-5 times per week for up to 3 months. The duration of each session was about 45 minutes. The goal of treatment was to increase passive and active joint range of motion through traction, active joint movements with passive stretching, and manual friction massage on trigger points. Subjects were instructed to perform these exercises at home in addition to touching their skin, avoiding the use of assistive devices, and ignoring their pain by eliminating pain complaints. The outcome measures included the VAS pain scale, Radboud Skills Test for upper extremity assessment, and maximum walking duration and speed for lower extremity function. This treatment was determined safe and effective to regain function despite temporarily increasing pain. A full recovery was obtained in 46% of the subjects. The majority of subjects saw a reduction in painful symptoms and improved function.7

In a similar study, van de Meent et al8 investigated the PEPT approach on patients with acute CRPS Type I. Comparable progressive loading exercises and desensitization of the limb occurred through forced used and self-massage.8 Active and passive joint mobilization and stretching exercises targeted specific functions.8 The patients had 6 formal, hour long sessions over a 3 month period. However, the subjects were instructed to perform this intervention at home. Measures involving body function, activities and participation, and personal factors were included. This program resulted in significant improvements in pain, pain intensity, muscle strength, upper extremity function, walking speed, disability, kinesiophobia, and quality of life.8 This study reiterates that PEPT is an effective treatment and also appropriate for acute cases of CRPS.

CRPS is known to cause an altered mental representation of the affected limb. As a result, patients lack the awareness of limb positioning. Lewis et al6 examined how vision influences positioning and self-perception of the affected limb.6 The study showed that limb placement was more accurate with visual input and gave patients increased limb awareness, but did not improved proprioception.6 This deficit is worrisome as it can result in injury. Therefore, patients should be educated regarding visual strategies to ensure safe positioning, improved accuracy, and success during therapy and functional tasks. Additionally, integrating visual feedback may help to reorganize their altered cortical representation and body schema.6

Another encouraging intervention for CRPS is mirror therapy. Mirror therapy aims to restore the body schema by correcting the altered sensory-motor cortical connection.11 This therapy was first utilized by amputees with phantom pain.10 Patients with stroke and CRPS are finding the benefits of this treatment approach as well.10,11 A study by Cacchio et al10 investigated the effects of mirror therapy in patients who developed CRPS Type I after a stroke.10 Mirror therapy was performed in addition to the normal neurological rehabilitation for stroke 5 times a week for 4 weeks. The subjects who performed mirror therapy had significant improvements in pain and function that were then maintained at the 6 month follow up period.10 The authors suggested that mirror therapy is indicated for patients that seek pain reduction and for those who no longer respond to conventional physical therapy. 10 Other studies note that the chronicity of CRPS plays a significant role in the degree of pain reduction.11,12  Studies by McCabe show that subjects with more acute symptoms, which is define as one year or less, experience more pain relief. Once CRPS becomes a chronic condition the evidence shows that the pain is too unbearable and mirror therapy is ineffective.12,13

However, the addition of mental imagery processing (MIP) prior to mirror therapy in chronic cases of CRPS may be more successful in minimizing pain and regaining function.13 Moseley reasoned that MIP would retrain the brain by first activating the pre-motor cortices and mimicking normal motor planning.12 Therefore, the sequence of MIP is important.13,14 The MIP stages are 1) recognition of hand laterally, 2) imagined hand movements, and 3) mirror movements.13 The first stage involved the patient mentally discerning the right or left hand of photographs as quickly and accurately as possible. In the second stage, the subject accurately imagined various hand postures from the given photographs. The recommended frequency for the first two stages was 3 times per hour for 2 weeks. The final stage involved mirror therapy where the patient assumed a certain hand position with both hands as accurately as possible 10 times per hour. This sequence of mental imagery resulted in decreased pain and swelling of the affected limb.13 Furthermore, some of the subjects in this study no longer met the IASP criteria for CRPS.13

In conclusion, CRPS is a debilitating syndrome that can be difficult to diagnose due to its mysterious complexity. As a result, physical functioning, activities, and participation are negatively influenced. Physical therapists may be one of the first practitioners to encounter these symptoms; therefore, the recognition and understanding of CRPS is imperative to maintain function and prevent further disability. The described physical therapy interventions provide us with the tools to treat both acute and chronic cases of CRPS primarily through cortical reorganization. These interventions are practical, non-invasive, and cost effective.11 Throughout the intervention, physical therapists should provide emotional support and encouragement to obtain continued treatment compliance and patient success.7,8 These current treatments are promising; however, further research is needed to determine the cause of CRPS and the preferred therapeutic interventions.

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