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# An Osteopathic Approach to Complex Regional Pain Syndrome (CRPS)

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#### CASE REPORT

# Abstract

Complex Regional Pain Syndrome (CRPS) is a chronic neuropathic pain condition in a region of the body where the pain experienced by the patient is disproportionate to the stimuli preceding the pain. In this case, a 52-year-old post-menopausal woman presents with chronic distal limb pain due to a left ankle contusion from a work injury. Previous treatments that focused on specific symptoms failed. However, the patient was then evaluated and treated comprehensively by an osteopathic physician.

Treatment was tailored to individual patient needs based on the five models of osteopathic care. Within a 1.5 years period of integrative osteopathic treatment that utilized osteopathic manipulative treatment (OMT) in addition to medications and supplements, the patient was able to start walking again with only mild discomfort. This individualized approach seemed to improve her quality of life, and overall satisfaction with her health, psyche, and well-being. The patient is now discharged from the practice, has resumed normal daily activities, and is working full-time as a cashier.

## Background

Chronic pain conditions have increasingly become one of the most common and costly afflictions affecting Americans, with more than 100 million Americans suffering from some form of chronic pain, costing an estimated \$600 billion dollars in lost productivity and health care costs.<sup>1</sup> Complex Regional Pain Syndrome (CRPS), previously known as Reflex Sympathetic Dystrophy, is a post traumatic neuropathic pain condition which occurs regionally in one or more limbs, and manifests through autonomic, motor, and sensory dysfunction. CRPS can be divided into type I or type II, with Type I being more common than Type II.<sup>2</sup> Type I patients develop symptoms without an indication of nerve damage, while type II patients develop symptoms after an incident which produces nerve damage. The reported incidence of CRPS can vary widely depending on the diagnostic criteria with an incidence of CRPS I to be between 5 and 26 cases per 100,000 person years.<sup>2</sup> There is a greater incidence of CRPS found in women, especially postmenopausal women.<sup>2</sup>

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CRPS is characterized by persistent episodes of over-amplified pain that is disproportionate to the stimuli preceding the pain. Patients also present with edema, abnormal blood flow to the skin, abnormal skin color, texture, and temperature, increased sweating, muscle and/or joint weakness, and burning pain, which worsens distally in the affected limb.<sup>3,4</sup>

Diagnosis for CRPS is made through clinical examination, patient history, and signs and symptoms present in the patient, since there is no specific diagnostic test for CRPS.<sup>2,3</sup> Diagnostic criteria for CRPS include having persistent chronic pain which is not appropriate to the inciting stimuli, and having at least 1 symptom in 3 of the following 4 categories in Table 1.

Although there is no single pathophysiologic mechanism which leads to CRPS, some of the multiple pathophysiological features include dysfunction in inflammatory, vasomotor, and neurological mechanisms.<sup>4,5</sup> Inflammation and pain may be caused by an increase in proinflammatory cytokines in response to even the slightest trauma to the peripheral afferent c fiber nerves, which leads to

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an increase in the release of inflammatory neuropeptides, such as Substance P, calcitonin-gene-related peptide (CGRP), and bradykinin, from the affected neurons. This increase causes vasodilation and produces the symptoms of edema, erythema, and warmth, that are classic presentations of neurogenic inflammation.<sup>2,4,5</sup> CRPS is a multifactorial disease affecting the peripheral and central nervous systems through an over-amplified pain response elicited by hypersympathetic tone, causing central sensitization in the spinal cord and allowing for exaggerated response to noxious stimuli, leading to a seemingly endless cycle of pain and inflammation for the patient.<sup>4,5</sup> A debilitating condition, CRPS also often has an effect on the patient's psychological well-being.

Current treatment options for CRPS include rehabilitation, physical therapy, and psychotherapy. A combination of pain and neurological medications, such as tricyclic antidepressants, gabapentin, and opioid pain medications, may also be used in management of CPRS.<sup>2,6</sup> Prognosis for CRPS is best in mild cases, and cases where diagnosis is made early on. Moderate to severe cases can lead to chronic pain conditions, which require multidisciplinary treatment.<sup>5,6</sup>

In this case, the patient presented with moderate-severe CRPS that limited the patient's daily activities. The chronic pain led to the patient feeling frustrated and hopeless for future recovery. Physical therapy, pain management, neurology, and orthopedic referrals previously provided no significant benefit to the patient, especially when some physicians indicated that her condition may spread, rather than be reversed or maintained.

The osteopathic approach of diagnosis and treatment is based on the 5 models of osteopathic medicine, whereby the patient is evaluated and treated through the lens of the following: biomechanical, respiratory-circulatory, neurological, metabolic, and behavioral<sup>7</sup> models. Information gleaned through each of these perspectives works together to allow osteopathic physicians to comprehensively understand the pathophysiology and imbalances seen within their patients. Treating the person in pain as a unit allows the opportunity for self-healing, self-regulation, and long-term health maintenance.<sup>1</sup> An integrative osteopathic approach to CRPS is explored in the context of the following case report.

# **Patient Information**

#### Past Medical History

A postmenopausal 52-year-old female with a past medical and surgical history of hypothyroidism and chronic abdominal and pelvic pain due to complications following a total abdominal hysterectomy and bilateral oophorectomy, presents with left ankle pain. The left ankle pain was due to a work injury where a shopping cart struck the patient's left achilles tendon in November 2015.

Left ankle and foot pain were intolerant to heat and contact on the first visit. Patient had to cover her ankle and foot during showers or leave them outside of the water stream, because even warm water aggravated the pain. Initially, the patient could not even tolerate a sock on her foot.

Patient was not taking any medications to manage the hypothyroidism at the time of evaluation. Allergies to pain medications such as Vicodin and Oxycodone left the patient with few options for pain control. She presented on a regimen of Nortriptyline 75 mg PO daily and Aspirin 325 mg PO daily to help manage the neuropathic pain. She had a history of attending pain management classes to help manage the chronic neuropathic abdominal and pain that persisted, despite the emergent supracervical hysterectomy that was done to help alleviate the pelvic pain in late 2008. Post-operative bleeding and other complications led to lysis of adhesions later in April 2009, and the patient noted the pelvic pain changed from a sharp pain prior to the hysterectomy to a burning pain post-operatively. During the initial interview, she disclosed taking up to 4 full strength aspirin tablets when the pain was severe.

Her pain was not well controlled at the initial visit, rating it at a 7/10. In this case, the patient presented with moderate-severe CRPS which limited the patient's mobility and daily activities.

# **Clinical Findings**

#### **Initial Physical Examination**

At the initial visit, the patient was on crutches with a walking boot on her left leg, and showed discomfort in bearing weight on the left leg. Primary physical exam findings were as noted in Table 2.

#### Initial Osteopathic Structural Examination

The patient's initial osteopathic exam revealed the following dysfunctions noted in Table 3.

# Diagnosis

CRPS type I is preliminarily diagnosed after initial physical examination and a review of the patient's symptoms and past medical history. An MRI ordered by the neurologist in November 2016 failed

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	Sensory	Vasomotor	Sudomotor	Motor/Trophic
•	hyperesthesia and/or allodynia	<ul> <li>asymmetrical tempera- ture</li> <li>skin color asymmetry</li> </ul>	<ul> <li>edema</li> <li>changes in sweat patterns</li> </ul>	<ul> <li>motor dysfunction</li> <li>decreased range of motion</li> <li>changes in hair, nail, skin growth or texture</li> </ul>

 Table 1. Diagnostic criteria for CRPS.<sup>2-4</sup>

Vitals	Temp: 98.3 F BP: 114/60 mm Hg HR: 86 bpm RR: 14 rpm			
General	Well developed, well nourished, arrived in no acute distress, but throughout the visit leapt up or right leg holding left leg. Varied positions, sometimes sat on the floor holding the left leg.			
Cardio	RRR, no clicks or murmurs, no cyanosis			
Respiratory	Lungs CTA, A and P, B/L			
Abdomen	No hepatosplenomegaly. Abdominal tenderness to palpation in bilateral lower quadrants of the abdo- men with no rebound or guarding.			
Neuro/MSK	Cranial nerves II-XII intact. Sensation intact, except for LLE. Allodynia and hyperalgesia of the left leg below the knee which worsened distally. Strength 5/5 in upper and lower extremities except for left ankle dorsiflexion and plantarflexion, which are severely limited by pain. Unable to extend knee fully secondary to pain.			
Integumentary	egumentary Left ankle appeared swollen, bruised, warm, and scaly to the touch. No hair growth on the left lo extremity below the knee, despite the patient not having shaved for 5 months.			

 Table 2. Primary physical exam.

Head	Right occipitomastoid compression, Sphenobasilar synchondrosis compression		
Cervical	Right C2 flexed, rotated left, sidebent left		
Thoracic	T1 extended rotated right sidebent right		
Ribs	Ribs Rib 1 right superior		
Lumbar	hbar L1 extended rotated right sidebent right		
Sacrum/Pelvis	m/Pelvis		
Lower Extremity	Left femoral head anterior and left anterior fibular head		
Abdomen	bdomen Diffuse unspecified lower abdominal pain, firmness in the soft tissues overlying the anterior celiac and inferior mesenteric ganglion.		

 Table 3. Initial osteopathic structural examination.

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to reveal nerve damage and demonstrated an intact achilles tendon. As a result, a diagnosis of CRPS type II was less likely.

To further evaluate nerve function, a nerve conduction study was recommended by both the neurologist and the treating physician, but the patient refused. Inflammatory and micronutrient labs were ordered through SpectraCell Laboratories, and revealed elevated high sensitivity C-Reactive Protein (CRP-hs) and deficiencies in oleic acid, calcium, coenzyme Q10, glutamine, and vitamins B1, B3, B6, K2, and D3. A Dried Urine Test for Comprehensive Hormone

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Osteopathic Model	Imbalanced State	Balancing Treatment	Treatment Outcome
Biomechanical	Somatic dysfunction of biome- chanical origin which may led to restricted range of mo- tion and pain experienced by patient	1. OMT (HVLA, muscle energy, osteopathic cranial manipula- tive medicine)	Somatic dysfunction improved after every OMT session as well as over the time course of multiple treatments. Patient was able to regain better range of motion and decreased pain perception.
Respiratory- Circulatory	Somatic dysfunction that limits appropriate lymphatic, arterial, venous flow Edema	1. OMT, especially treatment targeting specific dysfunc- tions like thoracoabdominal diaphragm, thoracic inlet, and pelvic diaphragm, pectoralis tension, and lymphatic pump technique	Improved lymphatic and venous flow and circulation, decreased edema in distal left lower limb
Metabolic	Fatigue, inflammation, abdomi- nal pain, endocrine imbalance, heat intolerance, temperature changes in affected limb	<ol> <li>Anti-inflammatory diet</li> <li>Custom Multinutrient based on deficiencies</li> <li>Stress and well-being sup- port supplements</li> </ol>	Balanced hormone. Decreased fatigue.
Neurologic	Over amplified nociceptive response, imbalance of the autonomic nervous system leading to hypersympathetic tone leading upregulation of interneurons and facilitation	1. OMT to balance Autonomic Nervous System (ANS), specifi- cally sympathetic areas (T10-L2) and parasympathetic (sacral and cranial, OA, occiput, C1, C2) 2. Pain cream 3. Inflammation support supplements	Perception of pain decreased overall, averaging from 7-8/10 at initial presentation to 5/10 by the 12th visit and 1/10 by the 26 <sup>th</sup> visit.
Behavioral	Lack of hope, spiritual disconnect	<ol> <li>Individually tailored plan for recovery with realistic hope for improvement based on previ- ous physician outcome</li> <li>Discussed the patient's grief reaction that occurred in response to her chronic pain.</li> <li>Elaborated on how reducing inflammation and proper medi- cation management will help reduce her pain, which is tied to her grief.</li> </ol>	Reconnected with personal spiri- tual beliefs and through compre- hensive treatment with all of the other osteopathic models, the patient eventually felt well enough to observe Ramadan, which she had not been previously able to do. She also felt well enough to resume religious services on a weekly basis. Patient displayed less psychologic distress over time and increased sense of well-being.

**Table 4.** Patient treatment and treatment outcomes based on the Five Models of Osteopathic Medicine.

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(DUTCH) panel was ordered through Precision Analytical, which indicated hormone dysregulation with poor conversion of free cortisol to metabolized cortisol, as well as a high estrogen/progesterone ratio.

### **Treatment and Treatment Outcomes**

Through a total of 26 visits over the course of a year and a half, the patient was provided with a targeted treatment plan which addressed each body system imbalance in concordance with the 5 models of osteopathic medicine (Table 4).

To address the biomechanical and respiratory-circulatory model of osteopathic medicine, OMT was used to treat edema and the musculoskeletal system by resolving somatic dysfunction of the head, cervical, thoracic, abdomen, lumbosacral, pelvic, and upper/lower extremity regions noted in each visit.

Osteopathic manipulative techniques used included balanced ligamentous tension, counterstrain, HVLA, muscle energy, myofascial release, and osteopathic cranial manipulative medicine. Each treatment focused on improving range of motion and circulatory flow by decreasing mechanical and circulatory restrictions and realigning the patient into an optimal state of function. In repeat osteopathic examinations, the patient showed improvement in each region of the body, with improved mobility and circulation, as well as decreased allodynia and hyperalgesia.

The neurologic and metabolic model was observed when addressing the neurological dysfunction (pain) that was treated by prescribing an inflammation support supplement, which was a combination of anti-inflammatory herbs, nutrients, and proteolytic enzymes including serratiopeptidase protease, chymotrypsin, trypsin, curcuminoids, boswellia extract, ginger extract, quercetin, rutin, rosemary extract, and trans resveratrol. Serratiopeptidase is a proteolytic enzyme which has potent anti-inflammatory properties and is widely used for pain and anti-inflammatory treatment in Europe and Japan.8 Serratiopeptidase, chymotrypsin, and trypsin have shown significant anti-inflammatory activity alone as well as in combination in comparative animal studies.9 Bosweillia extract is an extracted resin that contains acetyl-11-keto-boswellic acid that is known to be a potent inhibitor of 5-lipoxygenase enzyme that is involved in inflammation according to animal and human models.<sup>10</sup> Ginger and rosemary have also been shown to inhibit inflammatory mediators.<sup>11</sup> Quercetin, rutin, and trans resveratrol are components found in plant flavonoids which have been shown to inhibit both acute and chronic phase of inflammation in animal models.<sup>12,13</sup>

In addition, a topical combination pain cream with gabapentin (6%), ketamine (5%), ketoprofen (10%), and lidocaine (5%) and



Figure 1. Patient Timeline of Functional Improvement. Visits 19-26.

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separately, a topical 0.1% capsaicin cream was prescribed to help manage the pain, but also to decrease the cycle of nociceptive input leading to hyperalgesia and increased pain perception.

The metabolic model was used to address hormone and nutrient dysfunctions discovered in the results of the DUTCH and Spectra-Cell tests. The patient was prescribed eleuthero, American ginseng, ashwagandha, and rhodiola, to improve her stress level and quality of life.<sup>14,15,16</sup> A custom multinutrient supplement was formulated for the patient via Personalized Nutrients to correct the deficiencies of oleic acid, calcium, coenzyme Q10, glutamine and vitamins B1, B3, B6, K2, D3 that the SpectraCell micronutrient test uncovered. Oleic acid helps Vitamin A absorption, and Vitamin A deficiency can worsen the severity of inflammation. Calcium has a role in neural pain transmission. Glutamine deficiencies are associated with increased inflammatory cytokine production. Coenzyme Q10 has an effect on decreasing inflammatory markers such as CRP and IL-6. Vitamin B6 deficiencies are associated with elevated CRP and systemic inflammation. Vitamin D inhibits pro-inflammatory cytokines and decreases chronic inflammatory pathways.<sup>17</sup> She was also prescribed a progesterone cream to balance her relative estrogen excess in an effort to improve her pain threshold.<sup>18</sup> The metabolic model was also used by emphasizing the importance of consuming whole organic foods with anti-inflammatory spices, such as cloves, ginger, and turmeric, to assist with pain management. The patient was also provided with a recipe for turmeric tea to aid in decreasing inflammation.19

The behavioral model was employed to treat the patient's lack of hope and spiritual disconnect due to her inability to participate in religious events and holidays, as well as the poor outcome CRPS tends to have. Although the patient refused psychotherapy, discussing the patient's reaction to living with chronic pain and tailoring a systematic treatment plan helped regain her hope in recovery. The patient was encouraged to resume religious practices as soon as she felt well enough. Since the treating physician had previous success with a similar case of CRPS resolution, he was able to offer specific hope in this case.

Over the course of her treatments, the patient functionally improved within the context of each of the osteopathic models and experienced complete resolution of her clinical condition as seen in Figure 1.

# **Literature Search**

A literature search was completed in June 2019. PubMed and JAOA were searched using the following Mesh terms: "chronic regional

pain syndrome," "complex regional pain syndromes," "reflex sympathetic dystrophy," "causalgia," "osteopathic manipulative treatment," "manipulation, osteopathic," "musculoskeletal manipulations." A total of 84 citations were reviewed for relevance to the case report and appropriate articles were retrieved. Additional sources were found by reviewing the references within the articles and using suggested citations by PubMed. Results were used to provide background information on CRPS and how an osteopathic approach can be a novel and compelling approach to managing patients with CRPS. No studies or reports on the use of OMT for managing CRPS were found.

# Discussion

In this case report, the patient had significant physical improvement with a marked decrease in pain perception. OMT may have been able to alter the pain response by modulating vagal tone which can override and decrease sympathetic tone.<sup>20</sup> Chronic stress can lead to adrenal dysfunction through a hypersecretion of cortisol leading to immunosuppression and consequently inflammation. One major study found that OMT lowered the overall level of cortisol during mental stressors.<sup>21</sup> Since inflammation has systemic effects on the body, it is important to consider a multisystem approach to treating pain and inflammation as presented in this case report.

Successful treatment for CRPS has yet to be established, but an individualized approach that also uses natural methods of treatment was seen to mitigate the complex nature of this condition in this case. Recent medical literature published by John A. Jerome, PhD, in the Journal of the American Osteopathic Association has supported the use of OMT in treating chronic pain conditions: "The analgesic effects of touch, the activation of supraspinal mechanisms, oxytocin release, and empathic communication are valuable assets to the mind-body connection, strengthening a partnership based on trust and built on a foundation of core osteopathic principles."1 In combination with traditional therapy, OMT offers an immediate therapeutic intervention with minimal side effects that specifically targets inflammatory and nociceptive pathways involved in CRPS. The significant positive health outcomes observed in this patient may be applicable to treating future patients with CRPS using the 5 models of osteopathic medicine and OMT by creating a treatment plan which utilizes various modalities to augment the patient's natural healing process.

# Limitations

Many potential limitations exist in this particular case report. The limitations include a narrow case study that is not broadly applicable

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to all forms of chronic pain, a single patient's clinical outcome, a custom-tailored osteopathic approach with multiple treatment variables, the level of physician skill, and the particular patient population. This case study examined a female patient of middle eastern descent. The results may vary by differing patient demographics. A review of other combined successful treatment regimens would be helpful to compare the results found in this case and for future studies.

Although she was encouraged to retest serum levels on multiple occasions, the micronutrient deficiencies were not retested post interventions due to patient refusal. In light of her significant functional improvement she did not wish to incur further costs by retesting the deficiencies. This brings another to light another limitation, cost effectiveness of treatment. While micronutrient deficiencies can have far reaching effects on patient healing in the setting of inflammatory disease processes such as CRPS (with a delayed healing response and over amplified dysregulated inflammatory response), conventional serum testing often does not adequately reflect the effects of micronutrient levels at an intracellular level. However, specific micronutrient testing panels can become costly, especially when repeated over time. This barrier may be addressed by further research into how individualized treatments addressing specific micronutrient deficiencies can have an overall impact on healing in patients with chronic pain conditions, such as CRPS, to allow for micronutrient testing to become a more conventional diagnostic modality.

The very definition of the "osteopathic" approach is an individualized treatment approach taking into account all of the multiple factors affecting a patient's disease process and addressing each factor to augment the patient's natural healing process. In order to translate this approach to a larger population, each treatment plan would have to be individualized for each person in the group. This makes it more difficult to "standardize" such treatment into a protocol, which is why we present this approach as a case study to illustrate how a comprehensive yet individualized treatment plan can benefit those with such unique and complex chronic pain conditions.

# Conclusion

The success of this CRPS patient provides insight on the efficacy and positive health outcomes that an osteopathic approach provides in addressing multisystem diseases such as CRPS, which affect the mind, body, and spirit. The five models of osteopathic medicine, which addressed the biomechanical, respiratory-circulatory, metabolic, neurological, and behavioral needs of this patient allowed for a comprehensive mind, body, and spirit approach to assessment and care of her CRPS. As the patient improved physically, her mental state and quality of life followed, allowing her to rebalance herself back into a state of health through an integrative osteopathic approach of healing. CRPS outcomes as reported in the literature are typically poor, with most moderate to severe case patients not showing any significant improvement.<sup>2,4</sup> Often times CRPS does not resolve, even after years or decades. At best, it does not worsen. Therefore, a span of 1.5 years, the duration of time to resolution of symptoms presented in this case study, is quite promising. An osteopathic approach to the whole person may lead to better clinical outcomes.

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