

# FUNCTIONAL RESTORATION AND COMPLEX REGIONAL PAIN SYNDROME

By Steven D. Feinberg, MD and Rachel M. Feinberg, PT, DPT

The functional restoration model—utilizing a carefully selected combination of therapies including medications, interventions, rehabilitation therapies, and psychological treatment approaches—may provide the best hope for treating CRPS.

*Too often, the treatment of Complex Regional Pain Syndrome (CRPS) consists of fragmented, “Let’s try this” interventions which are implemented haphazardly without an overriding treatment plan. Drs. Steven and Rachel Feinberg have written a comprehensive article on how to successfully treat CRPS in an integrated manner with the full, informed participation of the CRPS patient and their significant others.*

—James W. Broatch, MSW

Complex Regional Pain Syndrome (CRPS) is poorly understood by patients, their families, and healthcare professionals.<sup>1</sup> In some cases the condition is mild, in some it is moderate, and in others it is severe. CRPS remains an enigma and is difficult to treat, often leaving the physician frustrated and the patient severely compromised—physically and emotionally.

The tools in the physician’s armamentarium are many including a host of treatments including pharmacological, interventional, passive and active physical and occupational therapies, along with cognitive/psychosocial/behavioral approaches.

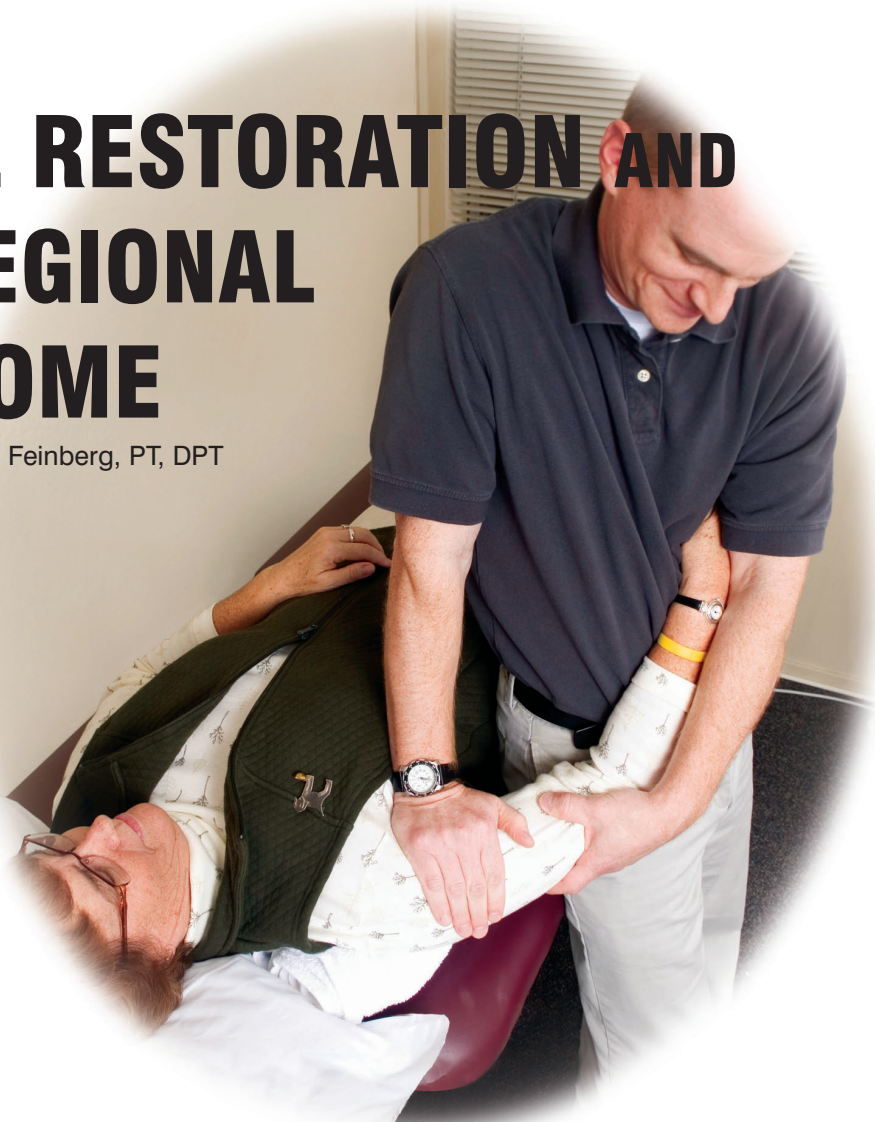
This article discusses active, functional restoration approaches and is not directed to various pharmacological, interventional, or other passive treatment approaches. The emphasis in this article on functional restoration is not meant to diminish the importance of other treatment approaches. In fact, while these other “passive” approaches sometimes

suffice alone to provide a good clinical outcome; more often than not with CRPS, they are not adequate alone, absent a “whole person” coordinated, goal-oriented, functional restoration approach.

## Functional Restoration

Functional restoration has historically and empirically been considered a critical and necessary component of interdisciplinary pain management programs for CRPS. Functional restoration emphasizes physical activity (“reanimation”), desensitization and normalization of sympathetic tone in the affected limb, and involves a steady progression from the most gentle, least invasive interventions to the ideal of complete rehabilitation in all aspects of the patient’s life.<sup>2</sup>

Historically, functional restoration is a term that was initially used for a variety of pain rehabilitation programs characterized by objective measure of physical function, intensive graded exercise, and multi-modal pain/disability management



with both psychological and case management features.

The concept of functional restoration was first described by Mayer and Gatchel<sup>3</sup> in the mid 1980s and the term “functional restoration” has, in recent years, become increasingly popular with evidenced-based medicine support and has been adopted as the treatment paradigm of choice for chronic conditions and particularly chronic pain states.<sup>4</sup>

Functional restoration chronic pain programs have strong support in the medical literature going back to the early 1990s and meet the criteria for evidence-based medicine (EBM).<sup>5</sup> In 1992, Flor and colleagues published a meta-analytic review on the efficacy of multidisciplinary pain treatment centers.<sup>6</sup>

In this article, the term functional restoration is used broadly and refers to a philosophy and approach to medical care, although the term is also used for specific types of programs.

Functional restoration is based on a *biopsychosocial model* of medical diagnosis and care that focuses on not just the biology (injury/illness and associated pathology), but also on the individual as a whole person, including psychological and social aspects.

Most physicians have been trained and are familiar with the *biomedical model*<sup>7</sup> which has traditionally viewed pain resulting from injury or illness in the context of those etiologic factors that resulted in the painful condition. The biomedical model assumes there is a causal relationship between a specific pathophysiology and the presence and extent of a particular symptom. While this biomedical model has served the medical community well in the treatment and cure of certain diseases, it often fails in the treatment of chronic pain and especially with CRPS.

In recent years, there has been an evolution in our understanding of pain as a biopsychosocial disease that can persist and grow—even well after the original injury has healed. We now recognize that pain causes structural and functional changes in the central nervous system that serve to amplify and maintain the experience and disability of pain.<sup>8</sup> This pain is then modified by many additional factors that are addressed in the biopsychosocial approach.

In the traditional biomedical model, complete relief of pain is clearly an endpoint that is highly desirable especially

in acute pain states, yet it is usually unattainable in chronic pain conditions. Evidence also suggests that factors other than the nature of the injury are primary determinants of disability and suggest that treating pain, even acute pain, should emphasize functional restoration in addition to relief of pain because the latter may reinforce psychological, environmental, and psychosocial factors that predispose progression to chronic pain states.

The biopsychosocial model<sup>9</sup> of pain recognizes that pain is ultimately the sum of the individual’s biology, psychological history and state, belief system about pain, along with interactions with the environment (workplace, home, disability system, and health care providers).<sup>10</sup> All of these factors can strongly influence symptom severity and how quickly the individual can be returned to a more functional life. In fact, the psychological and social factors can play a more significant role in disability than the biological factors.

Functional restoration can be defined as the process by which an individual acquires the skills, knowledge, and behavioral changes necessary to assume or re-assume primary responsibility for his/her physical and emotional well-being. Functional restoration thereby empowers the individual to achieve maximal functional independence, the capacity to regain or maximize activities of daily living, and return to vocational and avocational activities.

Fundamental elements of a functional restoration approach include assessment of the person’s dynamic physical, functional, and psychosocial status. This is followed by a treatment plan that includes directed conditioning and exercise, cognitive behavioral therapy, patient and family education and counseling, functional goal setting, ongoing assessment of participation and compliance, and progress toward achievement of goals.

This approach and these programs

*“Functional restoration involves multiple disciplines working together in a coordinated fashion and is focused on maximizing function, returning as close as possible to pre-injury productivity... while preventing needless disability, unnecessary medical and surgical care, and avoiding iatrogenic healthcare related complications.”*

While it takes more time to evaluate these non-physical psychosocial factors, they can often be crucial in helping to identify those individuals who are not responding to treatment. These patients should then be directed toward a more comprehensive evaluation and treatment program that can address these multiple factors. Without this early recognition and appropriate treatment of the at-risk patients—despite the good intentions of the treating physician—they may be subjected to many medical, interventional, and surgical procedures that serve only to worsen their pain and disability.

Functional restoration involves multiple disciplines working together in a coordinated fashion and is focused on maximizing function, returning as close as possible to pre-injury productivity (with sufficient functional capacity to avoid recurrent injuries), while preventing needless disability, unnecessary medical and surgical care, and avoiding iatrogenic healthcare related complications.

involve an integrated team of professionals providing intensive, coordinated care and may include pain specialist physicians, physical therapists, occupational therapists, psychologists, vocational counselors, nurses, and case managers—who all provide individualized treatment in a structured setting. Functional restoration treatment team members act as educators, de-emphasizing passive and/or palliative therapies, while emphasizing independent self-management. There should be a shift of health and well-being responsibility from the doctors and therapists to the person (the locus of control shifts to the patient).

A functional restoration approach can include the limited/adjunctive use of medications and appropriate interventions for the specific purpose of supporting the individual’s effort to reach and maintain maximum functional improvement, institution of preventive measures, expectation management, education for relapse prevention, proper activity and

work pacing, ergonomic accommodation, reengagement in recreational/avocational activities and, when appropriate, transitional return to gainful employment with as little disruption from the work site and coworkers, as possible.

Functional restoration involves direct treatment, objective measures of physical performance guiding exercise progression, education on pain management, along with addressing coping skills and fear-avoidance beliefs using a cognitive behavioral therapeutic (CBT) approach consistent with the biopsychosocial view of chronic pain/disability.

Ultimately, the successful individual with chronic pain takes control of—and reengages in—life activities and minimizes interactions with the medical community. The goal is a mitigation of suffering and return to a productive life despite having a chronic/persistent pain problem.

## CRPS Treatment Approaches

Functional restoration treatment approaches for CRPS are educational, cognitive and active and are directed to normalization of use. Treatment must be carefully balanced so as to avoid excessively aggravating activities involving the extremity that causes a worsening, rather than an improvement, of CRPS symptoms. This is a challenge to both the treater and the patient as one must distinguish between fear-avoidance versus true harm from activity. Often the approach is to find a “happy medium” where activity and exercise, while possibly uncomfortable, are helpful but not harmful.

## Patient Education

One of the first steps in treatment of CRPS is determining the patient’s current perception of the cause and meaning of the pain as well as expectations about the prognosis and treatment. Unfortunately, it is not uncommon that patients have either been told incorrect information from other sources or have misinterpreted education from a past provider. Many healthcare providers have only minimal exposure to assessing or treating CRPS and a lack of consistent information can confuse the patient. The patient can perceive that the doctor has been telling them that their symptoms are “all in their head.”

Physicians and therapists, treating in an acute care model, may have informed the patient not to use the limb if it was painful.

In this scenario, the patient associates use as sinister and damaging.

The patient may have lost all hope of recovery. For example, a patient with lower extremity CRPS that was resisting treatment commented to his physical therapist, “A doctor told me that I was going to eventually have my leg cut off anyway, so what is the point of forcing myself to walk on it.”

Another first step in educating the patient is to explain how functional restoration is different than other approaches. Due to the fact that patients have typically seen multiple doctors and therapists without benefit or with a worsening of symptoms, the patient can have little confidence that a functional restoration approach will be more effective than any of the other treatments that they have tried.

Education on diagnosis, prognosis, and expectations of treatment must begin as soon as possible. Many patients do not truly understand the diagnosis of CRPS and, more importantly, how it relates to their personal experience. This education should include an easy to understand discussion about changes in the nervous system and how that helps explain the symptoms of CRPS. As the patient is explaining his or her symptoms, it is important that they receive confirmation that all of those symptoms are “normal” for CRPS and that the variability in all of the symptoms is to be expected as well.

The patient should be made aware of the extent of effort and hard work that is involved in successful treatment. The patient must understand that treatment will provoke discomfort and may be perceived as painful but that they will receive help with managing these symptoms and that the outcome is significant improvement in functional use of the affected extremity. Many patients believe that the focus of treatment is to reduce their pain level. The impression is that if the pain level decreases, then the functional increases will soon follow. However, this is not always the case with CRPS. Unfortunately, pain levels may increase initially with treatment as the patient pushes past the current level of function. Therefore, education regarding goals based on function, not pain changes, is important to assist patients in feeling successful and attaining their goals. Interestingly, with increased function and psychological stabilization,

patients report either less pain or that the pain is less bothersome.

The patient must also be an active participant who takes control of his or her treatment and participates in goal setting. If the patient is unable or unwilling to participate completely with treatment, results are minimal. Goal setting can be directed towards functional activities that are important to the patient to assist them in becoming engaged in treatment. The functional restoration approach is an active model where the treater is an educator and the patient is responsible for his or her rehabilitation and restoration.

Patient education must also include possible negative consequences of not using the affected extremity. These include a worsening of symptoms in the affected limb, spreading of CRPS proximally or to the contralateral or other limbs, and/or symptoms due to compensatory movement and overuse, and development of secondary pain sites from guarding and abnormal movement.

## Fear of Re-injury or Fear of Movement

Fear of re-injury or fear of movement (kinesophobia) due to increased pain is a common barrier to returning to normal, work, or recreational activities after an injury. An individual’s pain-related fear-avoidance and catastrophizing (an exaggerated negative appraisal of pain and its meaning) appear to be prominent factors hampering functional recovery while augmenting disability<sup>11</sup> and are important factors in determining activity level 6-12 months after an injury.<sup>12</sup> The healthcare providers play a central role in providing information and education and thus greatly influence patients’ fears, avoidance attitudes, and beliefs.

Typically, as people recover from an injury, they try and push themselves to confront the pain by increasing the amount of social and physical activity they do. However, with CRPS, the patient—and often the provider—does not understand the exaggerated pain response and so CRPS is not immediately diagnosed. The unrelenting pain of CRPS increases underlying anxiety and fear of a more malicious, yet undiagnosed, disease process. Driven by fear of further pain, the patient increasingly restricts activities—despite the resolve of the original injury—and begins to exhibit a maladaptive avoidance response. This can lead to physical de-conditioning, loss of flexibil-

ity, loss of muscle strength, and an increase in muscle pain. Secondary psychological consequences with depression and anxiety are common.

Treatment to overcome fear avoidance includes education, repeated exposure to activities that have been avoided, and taking an active role in recovery. The patient is educated on how their beliefs and behaviors can lead to a vicious cycle that involves catastrophic thoughts, fear, avoidance, disability, and pain. The patient learns the difference between pain and damage, safe positioning, safe activity, and slow progression of exercise. The activity program consists of the fearful activities initially performed at low levels and then progressively increased on an individual basis.

### Flare Management

To a patient dealing with the overwhelming symptoms of CRPS, the pain can appear uncontrollable with no way to manage it. Flare-ups (an increase from the normal baseline level of pain) can cause both physical and emotional reactions. Physical reactions include tightening of muscles, holding one's breath, stomach and chest tightening, and nausea. Emotional reactions include anxiety, fear, worry, depression, anger, and feelings of being overwhelmed. When these physical and/or emotional reactions occur, the pain level worsens and propagates the cycle of flare-ups. Flare-up management is an essential part of the rehabilitation process. Without these tools, patients will have difficulty feeling in control of their symptoms and will remain fearful of pushing themselves physically.

During an activity, the patient is encouraged to take multiple breaks during activity to attempt to control the escalating symptoms of pain, fear, anxiety, or any other negative reaction. During this break, the patient focuses on relaxation breathing, stretching, cognitive behavior therapy practice, imagery, or any other task that assists them in calming their symptoms.

### Psychological Approaches

Psychosocial and behavioral factors play a significant role in the experience, maintenance, and exacerbation of pain.<sup>13</sup> A variety of factors can exacerbate the pain and dysfunction associated with complex regional pain syndrome (CRPS) and can help maintain the condition in

some patients. Effective management of CRPS requires that these psychosocial and behavioral aspects be addressed as part of an integrated multidisciplinary treatment approach.<sup>14</sup>

Factors such as mood, ability to manage stress, communication styles, beliefs about pain and coping styles can decrease the person's ability to control their pain. As pain persists, the person may develop negative beliefs about their experience of pain or negative thoughts about themselves and their role in their work or family. These types of thoughts, along with decreased participation in enjoyable and reinforcing activities, can lead a person to feel depressed and anxious. All of these factors can fuel and maintain the pain cycle.

Living with pain, especially one that can be as debilitating as CRPS, affects the person's life both directly and indirectly. The role in the family and relationships is altered, the patient's confidence can lessen, and thoughts of the future can

and support from others that have experienced similar suffering.

There are numerous approaches, including:

- Education on stress management and coping skills,
- Biofeedback,
- Mindfulness Meditation,
- Relaxation Training,
- Guided Imagery,
- Hypnosis, and
- Cognitive Behavioral Therapy.

### Physical Medicine Treatments

There are many physical medicine modalities that can be used passively and applied by a therapist, but CRPS is a chronic and constant problem and the direction of treatment should be to teach the individual self-management techniques. Passive treatments include massage, TENS, acupuncture, contrast baths, edema control treatments, and others. Active treatments include various desensitization techniques (brushing, material

*“The functional restoration approach is an active model where the treater is an educator and the patient is responsible for his or her rehabilitation and restoration.”*

become filled with anxiety. The patient's role in the family structure can change, typically from one of either providing for the family or a high level of responsibility and productivity, to being in the sick and dependent role. With a chronic condition that is poorly understood, the patient suffers further stress and anxiety as family and friends begin to question why the patient is “not fixed yet” and participating in activities. Increased financial stress is also common and adds to the burden of living with CRPS. The development of hopelessness and depression is common.

A functional restoration program not only allows the time to identify all of the psychosocial and behavioral factors that are playing a role in the person's chronic pain experience, but also provides education, support, and guidance that allows the person to change or manage the factors that are affecting his or her ability to control the pain. The group setting in a functional restoration program also gives the patient a sense of camaraderie

stimulus, etc.); active exercise or functional use; stress loading (scrubbing and carrying); and exposure therapy.

### Desensitization

One of the first steps in treatment of CRPS is desensitization. A desensitization program is aimed at normalizing sensation by providing consistent stimulus to the affected area for short periods of time, frequently throughout the day. The brain responds to this sensory input by acclimating to the sensation, thereby gradually decreasing the body's pain response to the particular stimuli. One of the main desensitization tasks that is focused on in a functional restoration program is decreasing the use of protective wraps or increasing the patient's tolerance to clothing. Hypersensitivity may lead the patients to either cover the affected extremity to protect it or the individual may be unable to cover or touch the extremity. For example, many patients with lower extremity CRPS are unable to wear long pants or cannot tolerate

wearing shoes other than sandals. Other patients use an ace bandage on their hand or arm to guard the extremity (in one particular case, an oven mitt was employed). In both situations, part of the patient's treatment is to expose the affected extremity to variable textures and conditions. More information on desensitization is available on the Reflex Sympathetic Dystrophy Syndrome Association web site at [www.rsds.org](http://www.rsds.org).

### Exposure Therapy

In cognitive behavioral treatments of fear and anxiety, exposure to the feared stimuli is an essential component. In order to reduce fear, the bio-informational theory of fear<sup>15</sup> predicts that first the fear network needs to be activated and, second, new information needs to be available that disconfirms the fear expectations that are inherent to the fear memory.<sup>16</sup> In graded exposure, the patient identifies situations that are 'dangerous' or 'threatening.' As a way to identify different situations, a photograph series of Daily Activities for the upper extremities (PHODA-UE)<sup>17</sup> or the lower extremities (PHODA-LE)<sup>18</sup> is used. The PHODA is a standardized method during which patients are requested to judge the threat value of various physical movements from daily life activities represented by photographs. By using the PHODA, a fear hierarchy can be established. Based on the graded hierarchy of fear-eliciting situations, individually-tailored practice tasks are developed. As much as possible, the patient performs certain activities or movements or stays in situations that he or she had been avoiding.<sup>19</sup>

In a functional restoration program, the patient participates in a type of graded exposure by performing exercises and functional activities that they have been avoiding. The patient begins at a level of activity that is just above their comfort level and is encouraged to slowly, but consistently, push that level further.

### Motor Imagery Program

Numerous peripheral and central changes have been demonstrated in CRPS. Some of the central changes include disruption of sensory cortical processing, disinhibition of the motor cortex, and disrupted body schema. In an effort to target these central changes, treatment consisting of graded motor imagery was created. The motor imagery

program is based on sequential activation of cortical pre-motor and motor networks via a hand laterality recognition task, imagined movements, and mirror therapy—specifically in that order.<sup>20</sup>

Of the three parts of a graded motor imagery program, mirror therapy has received the most attention recently. Mirror therapy involves the use of a mirror inside a box to provide visual input of normal movement from the unaffected limb (hand or foot) when simultaneously moving the hidden affected limb.

Mirror therapy is not invasive, has no adverse effects, and is not costly. The main difficulty is the proposed initial six week treatment protocol requirement to comply with the exercises 10 minutes of each waking hour and therapist visits three times a week. In the event of ongoing improvements, additional appointments and home treatments are indicated—provided there was continuing objective evidence of ongoing improvement after each treatment increment.

### Aerobic Conditioning, Strengthening, and Stretching

These approaches are all active and can be incorporated into a home or fitness center exercise program. They are all geared initially to physical reactivation and use of the limb—within reason and to the extent possible—but provide considerable value to other, non-affected body parts. Physical activity not only provides for fitness and health, it appears alone to provide pain reduction benefits possibly through endorphin release and also serves to utilize time and keep the individual occupied. It also has the potential for socialization in a group setting (i.e., walking, at a fitness center, etc.)

These activities initially focus on correcting postural abnormalities, normalizing movement patterns, and overcoming avoidance. Depending on the patient's current level of disuse, each specific stretching or strengthening activity is modified to allow the patient to successfully complete the task. As the patient regains normalized movement patterns, increases their tolerance to use of the affected limb, and is able to participate with relaxed and smooth movement, the exercises are incrementally progressed for further flexibility and strength gains. Treatments include:

- Stress Loading,
- Strengthening,

- General Aerobic Conditioning,
- Stabilization,
- Postural Normalization/Balanced Use, and
- Various Movement Therapies (i.e., Yoga, Tai Chi, etc.)

A trial of aquatic therapy may be beneficial for individuals who have co-morbidities that preclude effective participation in a weight-bearing physical activity. Hydrostatic principals and buoyancy also provide assistance in edema control and lessening stress on the affected joints.

### Functional Activities

A functional restoration program places a majority of the focus on assisting the patient in increasing their ability to perform daily or work activities. Goals are typically based on functional activities and these activities are practiced heavily in the program. Functional activities include general tasks such as lifting, carrying, pushing/pulling, as well as activities of daily living and recreational activities. Treatment begins by assisting patients in determining their current level of function in a variety of different activities. For some patients this may mean lifting one pound and for others it may mean holding a toothbrush. The patient is then educated on correcting abnormal movement patterns such as guarding or compensatory movement while performing each functional task. Each task is practiced with appropriate pacing of activity, flare management, and slow progression. As the patient progresses, he or she is encouraged to integrate this practice into all home or work activities.

Recreational activities serve many purposes including exercise, socialization, time utilization, and general enjoyment.

### Treatment of Secondary Conditions

Many individuals with CRPS develop secondary myofascial disorders which are amenable to treatment using both active and passive treatments. Dietary counseling for proper nutrition is important as lack of activity, depression, and certain medications may result in considerable weight gain. Counseling for use of substances (drugs, alcohol, and tobacco) is critically important as the individual with CRPS moves towards a healthier lifestyle. Sexual dysfunction is common—whether from pain with movement, medications, or depression—and evaluation, counseling, and treatment should be provided.

Attention should be directed to any sleep disturbance since it is common and may have a significant impact on pain, function, and the individual's emotional state.

### Changes to the Environment

While we often think of treatment as directed to the individual, it is just as important to "treat" the environment in which the individual has to function. Changes to the environment have the potential to lessen pain and dysfunction. While we may not change the condition or impairment, the disability can be significantly lessened with proper adaptive equipment, home modifications, and an ergonomic environment. Additionally, the individual's emotional state is positively impacted. Something as simple as hand controls on a car (when a lower limb is affected) may allow the individual mobility, independence, and a sense of control and well-being. An inexpensive cane may allow increased mobility while also reducing discomfort.

In general, the therapist (PT and OT) treating CRPS initially directs attention to normalizing sensation, promoting normal positioning, decreasing muscle guarding, minimizing edema, and increasing movement and functional use of the extremity in order to increase independence in all areas of activities of daily living (ADL).

### Case Study

Female patient 'V' was diagnosed with CRPS (RSD) after a right shoulder/upper extremity injury following a fall in 2004. She had received various medications and physical therapy without benefit and then underwent a failed right shoulder surgery and subsequently developed CRPS (RSD). Despite the best efforts of her treatment team, she was severely depressed, in chronic pain, and essentially had a useless right arm. Her family would help her with dressing and bathing.

She went through an outpatient, interdisciplinary, functional restoration chronic pain program in late 2006 and by the end of treatment was off of the majority of her medications (she was off all opioids) and had almost full use of her arm again. She was upbeat, excited to get on with her life and return to some type of work again. This case example is not unique. Her CRPS did not go away but her depression became less severe, she overcame the fear of using her arm, and her chronic pain became manageable. Her story has been captured on video and is available at the following website: [www.bapwc.com/sub/success\\_stories.jsp](http://www.bapwc.com/sub/success_stories.jsp).

### Summary

Complex Regional Pain Syndrome can be a devastating disorder wreaking havoc on the lives of people who develop this condition for unexpected and uncertain reasons. Some cases are mild and resolve with minimal treatment while other patients become extremely debilitated and dysfunctional, both physically and emotionally. The reader is encouraged to seek further information about CRPS and other Stories of Hope on the Reflex Sympathetic Dystrophy Syndrome Association web site at <http://www.rsds.org>.

We have found, in our clinical experience, that a carefully selected combination of therapies—including medications, interventions, rehabilitation therapies, and psychological treatment approaches in the context of a functional restoration model of care—provides the best hope for treating CRPS. ■



Steven D. Feinberg, MD ([www.Steven-FeinbergMD.com](http://www.Steven-FeinbergMD.com)) is a physiatrist and pain medicine specialist and Stanford Adjunct Clinical Professor practicing in Palo Alto and Los Gatos, California. He is a past president (1996) of the American Academy of Pain Medicine and serves on the Board of Directors of the American Chronic Pain Association.



Rachel M. Feinberg, PT, DPT has her doctorate in physical therapy. Both Drs. Feinberg provide care for CRPS patients at the Bay Area Pain & Wellness Center Functional Restoration Program (FRP) in Los Gatos, California ([www.bapwc.com](http://www.bapwc.com)).

### References

1. Reflex Sympathetic Dystrophy Syndrome Association ([www.rsds.org](http://www.rsds.org)). Accessed 8/14/08.
2. [www.rsds.org/3/clinical\\_guidelines/TXguidelines\\_interdisciplinary\\_care.pdf](http://www.rsds.org/3/clinical_guidelines/TXguidelines_interdisciplinary_care.pdf). Accessed 8/14/08.
3. Mayer TG, Gatchel RJ, Kishino N, et al. Objective assessment of spine function following industrial accident. A prospective study with comparison group and one-year follow-up. *Spine*. 1985. 10(6): 482-93.
4. ACOEM. Occupational Medicine Practice Guidelines, Chronic Pain Chapter Update American College of Occupational and Environmental Medicine. ([www.acoem.org](http://www.acoem.org)) Elk Grove Village, Illinois. 2008 (in press).
5. *Ibid*, ref 4.
6. Flor H, Fydrich T, and Turk DC. Efficacy of multidisciplinary pain treatment centers: A meta-analytic review. *Pain*. 1992. 4: 221-230.
7. Engel GL. The need for a new medical model: a challenge for biomedicine. *Science*. 1997. 196: 129-36.
8. Siddall PJ and Cousins MJ. Persistent pain: a disease entity. *Journal of Pain Symptom Management*. 2007. 33(2 Suppl): S4-S10.
9. *Ibid*, ref 7. pp 129-36.
10. Gatchel RJ and Okifuji A. Evidence-based scientific data documenting the treatment and cost-effectiveness of comprehensive pain programs for chronic nonmalignant pain. *J Pain*. 2006. 7(11): 779-793.
11. Peters ML, Vlaeyen JW, and Weber WE. The joint contribution of physical pathology, pain-related fear and catastrophizing to chronic pain disability. *Pain*. 2005. 113: 45-50.
12. de Jong JR, Johan WS, Vlaeyen JWS, Onghena P, Goossens MEJB, Geilen M, and Mulder H. Fear of Movement/(Re)injury in Chronic Low Back Pain Education or Exposure In Vivo as Mediator to Fear Reduction? *Clin J Pain*. 2005. 21: 9-17.
13. Turk d, Swanson K, and Tunks E. Psychological Approaches in the Treatment of Chronic Pain Patients-When Pills, Scalpels, and Needles Are Not Enough. *Can J Psychiatry*. 2008. 53(4): 213-223
14. Bruel S and Chung OY. Psychological and Behavioral Aspects of Complex Regional Pain Syndrome Management. *Clin J Pain*. June 2006. 22(5): 430-437.
15. Lang PJ, Bradley MM, and Cuthbert BN. Emotion and motivation: measuring affective perception. *J Clin Neurophysiol*. 1998. 15: 397-408.
16. *Ibid*, ref 12.
17. Dubbers AT and Vikström MH. *The Photograph Series of Daily Activities (PHODA): Cervical Spine and Shoulder*. CD-rom Version 1.2, Hogeschool Zuyd, University Maastricht and Institute for Rehabilitation Research (iRv), The Netherlands. 2003. Reviewed at [www.sciencedirect.com/science](http://www.sciencedirect.com/science) (Dubbers and Vikström, 2003). Accessed 8/14/08.
18. Jelinek S, Germes D, and Leyckes N. *The Photograph Series of Daily Activities (PHODA): Low Extremities*. CD-rom Version 1.2, Hogeschool Zuyd, University Maastricht and Institute for Rehabilitation Research (iRv), The Netherlands. 2003. Reviewed at [www.sciencedirect.com/science](http://www.sciencedirect.com/science) (Jelinek et al, 2003). Accessed 8/14/08.
19. Vlaeyen JW, de Jong JR, Geilen M, Heuts PH, van Breukelen G. The treatment of fear of movement/(re)injury in chronic low back pain: further evidence on the effectiveness of exposure in vivo. *Clin J Pain*. 2002. 18: 251-261.
20. Moseley G. Graded motor imagery for pathologic pain A randomized controlled trial. *Neurology*. 2006. 67: 2129-2134.