

# Extracorporeal Shock Wave Therapy for tTreating Complex Regional Pain Syndrome: A Case Report

## Kompleks Bölgesel Ağrı Sendromunun Tedavisinde Ekstrakorporeal Şok Dalgası Tedavisi: Olgu Sunumu

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**ABSTRACT** Complex regional pain syndrome (CRPS) is a chronic and painful condition that occurs especially in the upper extremity after a traumatic event. Here, we report the changes in pain, range of motion, and function after extracorporeal shock wave therapy (ESWT) in a patient with CRPS. A 68-year-old female patient, whose arm was in a short-arm circular cast due to a right distal radius fracture, was admitted to our clinic with complaints of pain, limitation of movement and discoloration of the hand. Pain was evaluated with a visual analog scale, hand functions with the MAYO wrist score and Quick-Disabilities of the Arm, Shoulder and Hand. ESWT was applied to the wrist for 5 sessions, 2 days a week. After ESWT, significant improvement was achieved in pain, edema, range of motions, and wrist and hand functions. ESWT may be preferred as a new treatment method in CRPS. Studies with large case series are needed to calculate the effective dose and determine the possible side effects.

**Keywords:** Complex regional pain syndrome; extracorporeal shock wave therapy; pain

**ÖZET** Kompleks bölgesel ağrı sendromu (KBAS), travmatik bir olay sonrasında özellikle üst ekstremitede ortaya çıkan, kronik ve ağrılı bir durumdur. Burada, KBAS'lı bir hastada ekstrakorporeal şok dalga tedavisi (ESWT) sonrası ağrı, hareket açıklığı ve fonksiyondaki değişikliği rapor ediyoruz. Sağ distal radius kırığı nedeniyle kolu kısa kol sirküler alçıda kalan 68 yaşında kadın hasta, ağrı, hareket kısıtlılığı ve elde renk değişikliği şikayetleri nedeniyle kliniğimize başvurdu. Ağrısı görsel analog ölçek, el fonksiyonları MAYO bilek skoru ve Quick-DASH ile değerlendirildi. ESWT el bileğine haftada 2 gün 5 seans uygulandı. ESWT sonrası ağrı, ödem, elde hareket aralığı, el bileği ve el fonksiyonlarında ciddi iyileşme sağlandı. ESWT, KBAS'da yeni bir tedavi yöntemi olarak tercih edilebilir. Etkin dozu hesaplamak ve olası yan etkileri belirlemek için geniş vaka serili çalışmalarına ihtiyaç vardır.

**Anahtar Kelimeler:** Ağrı; ekstrakorporeal şok dalga tedavisi; kompleks bölgesel ağrı sendromu

Complex regional pain syndrome (CRPS) is a chronic pain condition characterized by autonomic dysfunction, trophic changes, and inflammatory features that usually occurs secondary to a surgical procedure or previous trauma. Dystrophic changes in the skin, hyperalgesia, functional disorder, and tissue atrophy are the symptoms and clinical signs encoun-

tered in patients.<sup>1</sup> This syndrome, which causes profound changes in people's mental state and serious negative effects on the quality of daily life, is important both because of the difficulty in diagnosis and because there is no clear proven treatment yet. The syndrome occurs acutely in approximately 7% of patients with extremity fracture surgery or other in-

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juries. Many cases resolve completely within the 1<sup>st</sup> year, but some patients progress to the chronic form.<sup>2</sup> Although the etiology of CRPS is unknown, the main problem is that the pain pathway, which starts from the periphery and extends to the central nervous system, becomes highly sensitive and overactive.<sup>1</sup> The syndrome can only be diagnosed through clinical signs and symptoms. There is no test specific for the syndrome. There are few high-quality randomized controlled studies to support the effectiveness of the most commonly used methods for treating this syndrome, whose treatment is as challenging as its diagnosis. Available randomized studies suggest that physiotherapy, occupational therapy, medical treatment (bisphosphonates, calcitonin, free radical scavengers, oral corticosteroids), and spinal cord stimulation may be effective treatments.<sup>3</sup>

Extracorporeal shock wave therapy (ESWT) is a physical therapy method that allows microscopic environmental changes to be initiated in the tissue where its energy spreads. Shock waves are transient short-duration acoustic pulses with a high peak pressure. For approximately 30 years, ESWT has been used as an effective treatment to break down urinary tract stones. This technology has also emerged as an effective non-invasive treatment modality for various orthopedic and traumatic indications, including problematic soft tissue problems.<sup>4</sup> It has been proven to be effective in treating orthopedic disorders such as plantar fasciitis or lateral epicondylitis. ESWT treatment may usually cause mild discomfort, but it is not a painful procedure. During treatment without local anesthesia, patients usually experience tolerable tenderness.

There are studies applying ESWT in the treatment of functional disorders such as HO (Heterotopic Ossification), plantar fasciitis, delayed union/nonunion after fracture, and frozen shoulder, and the results are promising. ESWT has also been tried in the treatment of post-stroke shoulder-hand syndrome, and although there are conflicting results in the literature, it is considered an effective method in the treatment of PSSHS (Post-Stroke Shoulder-Hand Syndrome).<sup>5</sup> However, there are few studies in the literature that examine the effects of ESWT on CRPS. For this reason, this study examining the effects of ESWT, which can be considered as a potential treat-

ment method in CRPS, is important for future approaches. Here we present the case of a 68-year-old female patient who developed a radius fracture and CRPS after falling while walking. We expect that this case report will add to the existing literature on this subject.

## CASE REPORT

A 68-year-old female patient presented to our Physical Medicine and Rehabilitation polyclinic with complaints of pain and limitation of movement in her right wrist. The patient, who had diabetes mellitus, essential hypertension, and hypercholesterolemia in her medical history, developed a right distal radius fracture as a result of falling on her right arm while walking from her own level on February 3, 2023. The patient's wrist was reduced and placed in a short-arm circular cast, and elevation was recommended. The patient, whose right arm was in a cast for 1 month, applied to our physical medical treatment and rehabilitation clinic on the 10<sup>th</sup> week after the fracture due to constant pain, limited movement in the hand, and occasional discoloration on the hand.

In the physical examination of the patient, edema, sweating, and allodynia were detected in the right wrist and dorsum of the hand. The patient's right wrist movements were limited. The right hand wrist joint range of motion was measured as 40-20, 60-80, 10-20 degrees in flexion-extension, supination-pronation, and radial-ulnar deviation, respectively. The patient had hypesthesia in the dorsum of the right hand and wrist, in a region consistent with the injury area. The patient's pain was evaluated using the visual analog scale (VAS). The patient was asked to mark the severity of her pain on a 0-10 cm line, with 0: no pain and 10: the worst possible pain. Her pain was evaluated by VAS with a severity of 8 at night and 7 during the day. Diffuse areas of demineralization and subchondral osteoporosis were observed on the patient's wrist radiograph. The patient's hand/wrist radiographs taken at the time of admission are shown in [Figure 1](#) [Figure 2](#).

The functional status of the patient, who was thought to have developed CRPS type 1 considering the Budapest Criteria, was evaluated with the MAYO wrist score and Quick-DASH (Disabilities of the Arm, Shoulder and Hand) questionnaire. Informed

voluntary consent was obtained from the patient. The MAYO wrist score was 40 and the Quick-DASH score was 59. After our patient was diagnosed with CRPS, she was followed up in the inpatient service of our clinic, and 20 sessions of conventional hand rehabilitation therapy (joint range of motion exercises, stretching exercises, isometric strengthening exercises, desensitization, transcutaneous electrical stimulation, contrast bath) were applied to the patient during his hospitalization. A total of 5 sessions of ESWT were applied to the patient, who did not benefit from conventional hand rehabilitation treatment, 2 days a week. Before the procedure, the ESWT protocol published by the International Society for Musculoskeletal Shock Wave Therapy was considered for indications, contraindications and application methods. The patient was informed about the ESWT treatment and informed consent was obtained. Using the MODUS<sup>®</sup> branded radial type ESWT device (Modus Medical Devices, Ankara, Türkiye), 2000 pulses of 2 bar/mm<sup>2</sup> intensity were applied to the volar surface of the right wrist from a location away from the artery. The patient was using metformin 1000 mg (twice a day) and perindopril 5 mg (once a day) because of chronic diseases during the rehabilitation process. In addition, she used 500 mg paracetamol tablets (for headache reasons) for only 1 day during this period, and the medications she used were monitored throughout the rehabilitation period.

The patient's VAS score, ROM measurements and functional assessment scales were evaluated before ESWT treatment, after treatment and at the 4th week after ESWT. The VAS scores (day/night) were 5/3, 2/2 after treatment and at 4 weeks post-treatment. The MAYO wrist score was 65 after treatment and at 4 weeks post-treatment. Quick-DASH was scored 31,818/40.75 after treatment and at 4 weeks post-treatment. Wrist range of motions (ROM) were measured by a goniometer. Wrist flexion-extension, supination-pronation, radial-ulnar deviation values were 40-20, 60-80, 10-20/60-30, 70-85, 10-20/70-30, 70-85, 15-20, respectively, before treatment, after treatment, and at 4 weeks. After ESWT, substantial improvement was achieved in pain, edema, ROM, and wrist and hand functions. The patient's pain and functional assessments are summarized in [Table 1](#).



FIGURE 1: Lateral wrist radiograph of the patient showing areas of widespread demineralization and subchondral osteoporosis.



FIGURE 2: AP (Anterior-Posterior) radiograph of the patient's wrist showing areas of widespread demineralization and subchondral osteoporosis.



**TABLE 1:** Clinical (VAS) and functional (Wrist ROM, Q-DASH, The MAYO Wrist Score) data of the patient who underwent ESWT are expressed as before treatment, after treatment and 4 weeks after treatment.

Scales	Before ESWT treatment	After treatment	At the 4 <sup>th</sup> week after ESWT
VAS scores-day	8	5	2
VAS scores- night	7	3	2
The MAYO wrist score	40	65	65
Quick-DASH	59	31.818	40,75
Wrist flexion	40	60	70
Wrist extension	20	30	30
Wrist supination	60	70	70
Wrist pronation	80	85	85
Radial deviation	10	10	15
Ulnar deviation	20	20	20

VAS: Visual analogue scale; ROM: Range of motions; Q-DASH: Quick-Disabilities of the Arm, Shoulder and Hand; MAYO: Wrist Score

## DISCUSSION

Hand injuries are important because they often lead to disability and treatment costs are high. Early treatment of CRPS can control pain and prevent serious loss of function. Different approaches have been tried in this syndrome for which there is no clear proven treatment in the literature. While psychotherapy, occupational therapy, physiotherapy applications, and medical treatments seem to be the initial treatment options, invasive interventions can be applied in the early period in patients who do not respond to these treatments.<sup>6</sup> Breuer et al. administered 6 mg ibandronate infusion to patients every 3 days to obtain pilot data on the safety and efficacy of ibandronate, a highly potent bisphosphonate for the treatment of CRPS, and found significant changes in the BPI (Brief Pain Inventory) and NPQ (Neuropathic Pain Questionnaire) grades of patients.<sup>7</sup> However, it can be said that the drug used has limited use in patients with high comorbidity because of possible renal side effects. In a study by Van Eijs F. et al., 36 chronic CRPS-1 patients were treated with spinal cord stimulation and were evaluated in terms of brush-induced allodynia at the end of 1 year. A significant correlation was found between the success of the surgery and allodynia. The difference in the success rate after

1 year was statistically significant between the groups with and without allodynia. Five patients in the successfully treated group had severe allodynia (5/20; 25%) compared with 11 patients in the unsuccessfully treated group (11/16; 69%). Although this study has shown that spinal cord stimulation (SCS) is an effective method for the treatment of chronic CRPS-1, its disadvantages are that it is invasive and relatively expensive.<sup>8</sup> Therefore, the search for relatively inexpensive, noninvasive, safe and easily applicable treatment methods for the treatment of this potentially debilitating syndrome is gaining importance.

ESWT, which is used as an effective noninvasive treatment method in many orthopedic indications in the literature, has recently attracted attention with its effects such as tissue regeneration, triggering tissue inflammation through enzymatic/non enzymatic pathways and initiating angiogenesis via NO (Nitric Oxide)/vascular endothelial growth factor receptor. Various experimental and clinical studies have demonstrated the effectiveness of ESWT as a means of accelerating tissue repair and regeneration in various wounds.<sup>9</sup> However, the biomolecular mechanism behind the therapeutic effects of this treatment modality still remains unclear. One of the potential mechanisms is persistent and functional angiogenesis that continues with neovascularization.<sup>10</sup> Increased NO production is considered a possible mechanism that promotes recovery in ischemic tissue perfusion after shock wave therapy. This theory is supported by the finding that scar tissue vascular endothelial growth factor, the most potent inducer of angiogenesis, is acutely increased in response to ESWT.<sup>10</sup> ESWT, which is preferred as a treatment modality in disorders such as plantar fasciitis, iliotibial band disorder, epin calcanei and chronic enthesopathies, has recently been tried in limb fractures and post-fracture recovery period disorders. In their study, J Vogel et al. applied 3000 impulses with an energy density of 0.6 mJ/mm<sup>2</sup> with an experimental device to 52 patients with pseudoarthrosis. They compared the success rate of high-energy extracorporeal shock wave therapy instead of surgery, which is preferred as the gold standard treatment method for nonunion of the fracture site after fracture. His results showed that

ESWT had a significant success rate for treating nonunion after fracture.<sup>11</sup> In this context, the role of ESWT for treating CRPS, which can occur as a complication after limb fracture, raises curiosity. One of the studies in the literature aimed at satisfying this curiosity is the study called Shockwave therapy in the treatment of CRPS in the medial femoral condyle by Notarnicola, Angela et al. Here, 30 patients affected by medial femoral condyle CRPS, aged 25 to 65 years and who did not respond to previous standard physiotherapy and pharmacological treatment, were included in the study. The patients were treated with 4000 pulses of shock treatment 3 times , at 72-h intervals. The energy flow density was applied as 0.035 or 0.09 mJ/mm<sup>2</sup> depending on the patient's tolerance. Patients were evaluated with the VAS and the Knee Society Score (KSS) at 2-month and 6-month follow-ups, and a significant regression was observed in the VAS scores and significant improvements were noted in the KSS values.<sup>12</sup> In this context, in the present case report, we examined the effects of ESWT, which can be preferred as a potential treatment method in CRPS, which is an important complication after limb fractures or surgery, on pain, function and range of motion. According to the results we obtained, it provided regression in pain, improvement in dexterity functions and quality of life. It provided a significant increase in the range of motion and contributed to the patient's grasping, holding, and throwing movements. In order to talk about the role of ESWT for

treating CRPS, it is important to increase the number of studies on this subject. Our findings support Notarnicola, Angela et al.<sup>12</sup> In our case, CRPS developed in the wrist region and the number of ESWT pulses applied to our case was relatively lower and the application time was relatively longer. The application of low-pulse ESWT may have increased the patient's compliance with treatment and contributed to the functionality in CRPS, which is already a painful syndrome. Our case is important because it contains data contributing to the dose and duration of application of ESWT, which is a potential agent that can be preferred for treating CRPS in the future.

According to our results, extracorporeal shock wave therapy may be preferred as a new treatment method in this syndrome whose etiopathogenesis has not been fully clarified and for which there is no gold standard treatment. However, studies with large case series are needed to calculate the effective dose with high efficacy and minimal complications, to determine the possible side effects and to demonstrate the long-term results in patients. Because our patient received ESWT treatment immediately after the conventional rehabilitation program, it is difficult to say that the improvement in the pain scale and the significant improvements in functionality were due solely to ESWT. In the future, studies comparing the effects of ESWT and conventional rehabilitation programs can be conducted.

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