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Complex regional pain syndrome with radial nerve palsy: A multimodal rehabilitation approach

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ABSTRACT

Complex regional pain syndrome (CRPS) is a type of neuropathic pain that is most commonly triggered by upper extremity injuries or surgery. The most prevalent symptoms of this illness include pain, edoema, vasomotor changes, stiffness, and impaired functioning. The origin of our patient's CRPS type II was known, namely radial nerve palsy following multiple upper limb fractures, as demonstrated by the investigatory findings of the x-rays, nerve conduction velocity test, and Strength-duration curve. With the healing of the fractures, the symptoms of CRPS worsened, as did joint stiffness. The physiotherapy treatment plan was designed to alleviate symptoms and manage the nerve palsy, with the primary goal of achieving pain-free restricted motions in as much functional range as possible. The treatment yielded impressive results on the outcome measures used to assess after a month.

Keywords: Complex regional pain syndrome, radial nerve palsy, Reflex sympathetic dystrophy, multiple fractures, physiotherapy management.

1. INTRODUCTION

Complex regional pain syndrome (CRPS) is a form of regional pain with an unknown cause that usually develops after a small triggering event or trauma, such as a fracture, sprain, or surgery. Reflex sympathetic dystrophy (RSD), causalgia, algo dystrophy, and Sudeck's atrophy are all terms that have been used to describe a set of disorders known as CRPS (Kurt et al., 2016). The exact incidence of RSD is unknown, however, it is thought to be one case in every two thousand accidents (Kemler et al., 2001). RSD is a syndrome that includes pain that is out of proportion to the damage, vasomotor and trophic changes, stiffness, and impaired function (Watson and Carlson, 1987).

This case study features a young male patient who was involved in a terrible workplace accident that resulted in multiple fractures of his right upper arm. Because the humerus shaft fracture was also accompanied by an

indirect radial nerve injury. The limb was surgically repaired, but the nerve was missed. Radial nerve palsy results in discomfort, swelling, and paralysis of the wrist and finger extensor muscles following fracture management (Phansopkar et al., 2020). The illness was given the name CRPS type II since the symptoms might be associated with specific nerve damage (Stanton-Hicks, 2006). This case report presents an integrated approach to physiotherapy for patients with CRPS after radial nerve palsy.

2. PATIENT INFORMATION

A 26-year-old man suffered an industrial crush injury 2.5 months ago while working near heavy machinery, resulting in segmental fractures in the distal forearm bones and an oblique humerus fracture. The patient was transferred to a private hospital and treated with ORIF Plating for the humerus, ORIF with Plating for the radius, and ORIF with nailing for the ulna fracture. After the sutures were removed, the patient was released with no evidence of pus at the scar site. The patient developed pain, edema and stiffness in the right upper limb within 2.5 months post-surgery and were unable to dorsiflex the right wrist. For further evaluation and management, he was referred to our hospital. The clinical examination, x-rays, and nerve conduction tests, all led to the diagnosis of radial nerve injury, post-fracture along with wrist drop and Sudeck's osteodystrophy of the right upper limb.

Examination and Investigation

The patient described pain throughout the right upper limb that was aggravated by deep pressure and limb motions and eased by resting position since the traumatic injury. Symptoms aggravated over the last few weeks. Patient-reported 9/10 on NPRS during the limb movement and 5/10 on rest. On observation his right upper limb was in the following position: arm at the side of the body, elbow extended with an increased carrying angle, wrist and finger in a mild flexion position (Figure 1). There was a surgical scar mark evident over the mid-section of the arm, as well as the posterior portion of the elbow and the mid-section of the forearm.

Figure 1 Patient's normal resting position of the hand and suture scar on the forearm

Diffuse oedema was seen on the dorsum of the right forearm, wrist, and hand. The suture line scars were healthy and non-adhered when palpated. There was no deformity. Movement assessment revealed a full range of motion in the shoulder. The affected ROM has been mentioned in table 2. The patient was unable to perform even slight active extension of the wrist and fingers (signs of wrist drop) and also radial and ulnar deviations couldn't be performed in isolation, they were accompanied by wrist flexion. On manual muscle testing, the score of wrist and finger extensors was 1/5, 2/5 for supinator, 3/5 pronators, wrist, thumb, and elbow flexors. On the patient-specific functional scale, the patient scored 3/10, and on the Michigan hand outcome questionnaire patient score was as mentioned in the table 3. The investigation reports of x-ray (Figure 2), nerve conduction velocity (NCV) (Figure 3), and strength-duration (S-D) (Figure-4) curve confirmed right radial nerve palsy and provided the status of denervation.

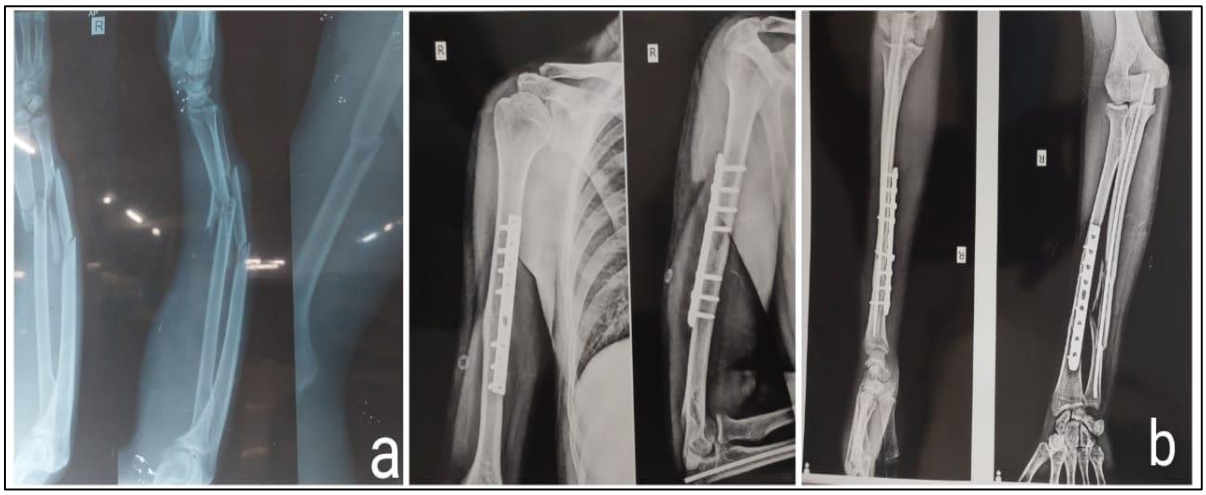
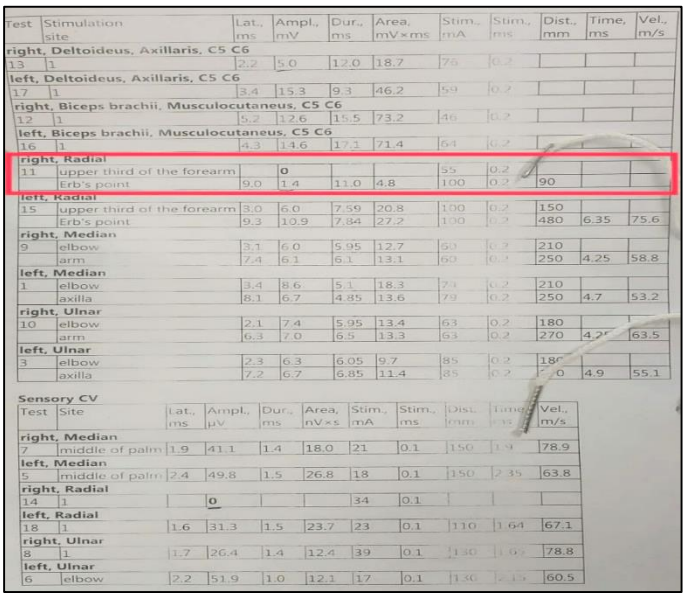


Figure 2 (a) Pre-op x-ray shows both bone fracture of three parts and midshaft fracture of the humerus (b) post-op x-ray: shows the internal fixation of the fractures with plating and screws.



Test	Stimulation site	Lat., ms	Ampl., mV	Dur., ms	Area, mV×ms	Stim., mA	Stim., ms	Dist., mm	Time, ms	Vel., m/s
right, Deltoideus, Axillaris, C5 C6										
13	1	2.2	5.0	12.0	18.7	75	0.2			
left, Deltoideus, Axillaris, C5 C6										
17	1	3.4	15.3	9.3	46.2	59	0.2			
right, Biceps brachii, Musculocutaneus, C5 C6										
12	1	5.2	12.6	15.5	73.2	46	0.2			
left, Biceps brachii, Musculocutaneus, C5 C6										
16	1	4.3	14.6	17.1	71.4	64	0.2			
right, Radial										
11	upper third of the forearm		0			55	0.2			
	Erb's point	9.0	1.4	11.0	4.8	100	0.2	90		
left, Radial										
15	upper third of the forearm	3.0	6.0	7.59	20.8	100	0.2	150		
	Erb's point	9.3	10.9	7.84	27.2	100	0.2	480	6.35	75.6
right, Median										
9	elbow	3.1	6.0	5.95	12.7	50	0.2	210		
	arm	7.4	6.1	6.1	13.1	60	0.2	250	4.25	58.8
left, Median										
1	elbow	3.4	8.6	5.1	18.3	71	0.2	210		
	axilla	8.1	6.7	4.85	13.6	79	0.2	250	4.7	53.2
right, Ulnar										
10	elbow	2.1	7.4	5.95	13.4	63	0.2	180		
	arm	6.3	7.0	6.5	13.3	63	0.2	270	4.2	63.5
left, Ulnar										
3	elbow	2.3	6.3	6.05	9.7	85	0.2	180		
	axilla	7.2	6.7	6.85	11.4	85	0.2	250	4.9	55.1

Sensory CV

Test	Site	Lat., ms	Ampl., μV	Dur., ms	Area, nV×s	Stim., mA	Stim., ms	Dist., mm	Time, ms	Vel., m/s
right, Median										
7	middle of palm	1.9	41.1	1.4	18.0	21	0.1	150	1.9	78.9
left, Median										
5	middle of palm	2.4	49.8	1.5	26.8	18	0.1	150	2.35	63.8
right, Radial										
14	1		0			34	0.1			
left, Radial										
18	1	1.6	31.3	1.5	23.7	23	0.1	110	1.64	67.1
right, Ulnar										
8	1	1.7	26.4	1.4	12.4	39	0.1	130	1.67	78.8
left, Ulnar										
6	elbow	2.2	51.9	1.0	12.1	17	0.1	130	2.15	60.5

Figure 3 Nerve conduction velocity reports revealed no electrical activity in the right radial nerve when stimulated at the upper third of the forearm.

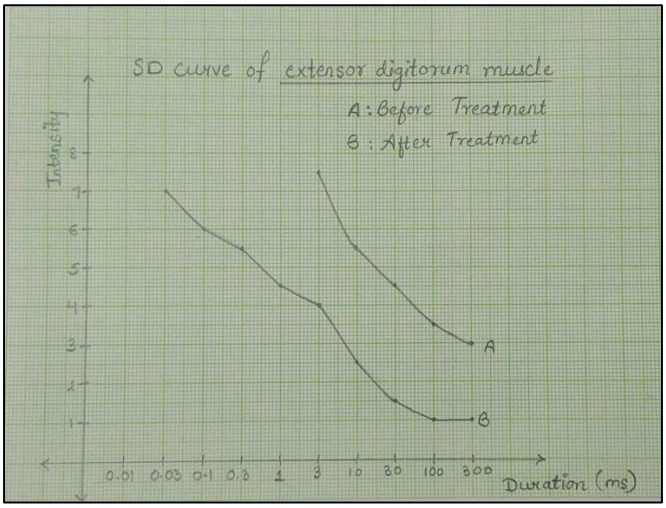


Figure 4 Strength duration curve of pre-post treatment for the extensor digitorum muscle supplied by posterior interosseous nerve a continuation of the radial nerve.

Therapeutic intervention

On the day of admission, the patient was examined, and therapy started shortly. The physiotherapy treatment was planned to recover from both CRPS and radial nerve palsy. It was developed and conducted over four weeks, with the first two weeks focusing on reducing CRPS symptoms mainly along with mild muscle stimulations. After the pain and swelling had subsided, the focus of treatment shifted to palsy management, which included muscle facilitation, strengthening, and joint range of motion exercises. Table 1 below summarises the entire treatment strategy, including goals, management approaches, and regimen.

Table 1 Physiotherapy treatment planned for the patient

Sr. No.	Therapeutic Goals	Intervention/ Treatment approach	Regimen	Duration (in weeks)-
1.	To reduce pain and oedema	Cold pack	Whenever the pain aggravates, mostly after the exercises for 5 minutes	1st-4th week
		TENS	Once a day applied in linear pattern.	1st-3rd week
2.	To facilitate the muscle education	EMS stimulation	current type-Intermittent Galvanic; Wavelength-Triangular; duration-30-30-30 stimulation. After 3 weeks the current was switched to surged faradic for muscle re-education	Intermittent Galvanic stimulation:1st-3rd week Surged faradic stimulation:3rd-4th week
		Visual Feedback exercises	As many times as possible by the patient throughout the day	1st-4th week
		assisted active exercises	10 reps x 3 times daily	1st-4th week
3.	To reduce the stiffness in the wrist joint and muscles	Paraffin wax bath	Once-daily	In the 3rd week only
		Stretches for wrist and finger flexors, extensors	10 reps x 3 times daily.	2nd-4th week
4.	To increase the range of movement	Maitland Wrist mobilization (Dorsal, volar, radial and ulnar glides)	2 or 3 glides per second in 1 to 2 minutes. 1 Set x twice daily.	Grade 1 and II:1st-2th week Grade III and IV: 3rd and 4th week
		Full Passive ROM exercises for elbow, wrist, and fingerers	Started with 5 reps but gradually the reps were increased.	1st-4th week
5.	To increase the strength of the muscles (Figure 5)	Functional hand retraining using clay, rubber bands, and springs (figure 5)	20 reps of each 3 times daily.	2nd-4th week
6.	To improve and maintain the function of hand positions	Dynamic cock-up splint	gradually reduced the wearing time	1st-3rd week
		Ergonomic advice	Usage of the right upper limb in all possible ADLs	Throughout the rehab and at the time of discharge.

Abbreviations: TENS: Transcutaneous electrical nerve stimulation; EMS: Electrical muscle stimulation; Reps: Repetitions; ROM: Range of motion; ADLs: Activities of daily living

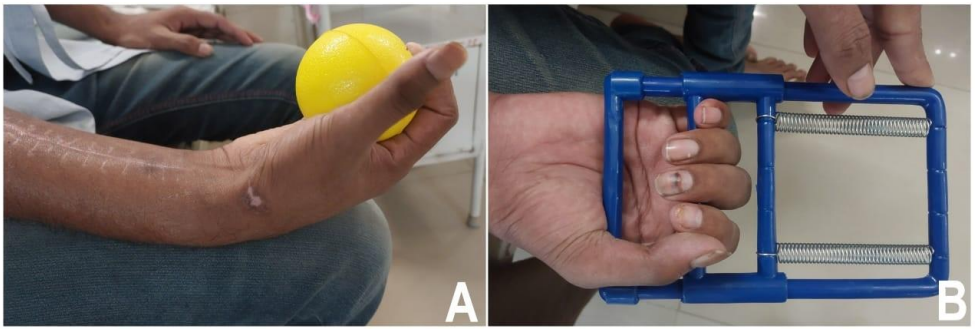


Figure 5 A & B depict the difficulty in making a fist, as well as hand gymnastic exercises performed with a sponge ball and springs.

Outcome measures

Once the patient demonstrated positive changes in the outcome measures at the time of post-treatment assessment, he was discharged. The patient marked a 5/10 on the NPRS when moving the right upper limb and a 1/10 while resting at the time of post-treatment evaluation. The wrist and finger extensors received a 2/5 on the manual muscle testing. The patient-specific functional scale received 6 out of 10 ratings. The ROM on the goniometer has improved, as seen in Table 2. The improvement in the Domains of the Michigan Hand Outcome Questionnaire demonstrates the success of the planned rehabilitation (Table 3). Figure 4 depicts the graph illustrating the nerve recovery status.

Table 2 Range of motions- pre-and post-treatment for all the wrist motions

Joint active ROM	Pre-treatment	Post-treatment
Wrist flexion	$0\text{-}40^{o}$	$0\text{-}60^{0}$
Wrist extension	Not able to perform	$0\text{-}30^{0}$
Radial deviation	$0\text{-}5^{0}$	$0\text{-}10^{0}$
Ulnar deviation	$0\text{-}10^{0}$	$0\text{-}25^{0}$
Forearm supination	$0\text{-}10^{0}$	$0\text{-}30^{0}$
Fingers extension (MCP)	Not able to perform	$0\text{-}10^{0}$
Thumb extension (CMC)	Not able to perform	$0\text{-}20^{0}$
Abbreviations: MCP: Metacarpophalangeal joint; CMC: Carpometacarpal joint		

Table 3 Domains of Michigan Hand Outcome Questionnaire and their pre and post-treatment values for the affected right extremity.

Domain	Pre-treatment values	Post Treatment values
Overall hand function	11	20
Activities of daily living	12	17
Pain	10	6
Aesthetics	9	12
Satisfaction	13	18
Work	17	11

3. DISCUSSION

The most common cause of CRPS in the upper extremity is trauma or surgery, although it can also arise as a result of a stroke, heart disease, or spontaneously (Kurt et al., 2016). In this case, the patient was diagnosed with type II CRPS after sustaining radial nerve damage as a result of multiple upper limb fractures. The radial nerve injury occurred two and a half months ago, however, therapy was overlooked at the time, resulting in the nerve's delayed recovery. Aside from that, Wallerian degeneration and nerve regeneration were predicted. As the fractures healed, the focus of treatment shifted to the resolution of the palsy and relief of CRPS symptoms. Physiotherapy has shown considerable effects in the first week of treatment in recently diagnosed CRPS (Kemler et al., 2001). The goal of our physiotherapy treatment was to achieve pain-free motions in as much functional range as possible.

The treatment began with pain management using cold therapy and TENS, which are useful in this situation, as well as massage, mobilization, and ROM exercises (Kurt et al., 2016). Following the reduction of pain and swelling, the treatment concentrated on the rehabilitation of muscle movement. Early spontaneous recovery from radial nerve palsy occurred at a mean of 6 weeks (range 3–24 weeks), with full radial nerve palsy recovery occurring at a mean of 17 weeks (range 3–70 weeks) post-injury (Bumbaširević et al., 2010). Intermittent galvanic stimulation was used for muscular facilitation and to preserve the physiological properties of the muscles throughout the first three weeks. After three weeks, the type of current was changed to a surged faradic current for muscle re-education. For joint stiffness, a paraffin wax bath with joint mobilization techniques was administered, which has been shown to produce excellent outcomes in the rehabilitation of post-traumatic stiff hands (Sibtain et al., 2013). Stretching of 3 sets of 10 repetitions with a hold of 30 seconds was shown to be most beneficial as stretching with a duration of 30 seconds (Bawiskar et al., 2020).

Other activities, such as Visual Feedback exercises, assisted active exercises, full passive ROM exercises, and hand gymnastics, were given to the patients to help with muscle contraction and strengthening. The patient was evaluated after 4 weeks of continuous treatment, and following satisfactory improvements, the patient was discharged with adequately explained ergonomic recommendations.

4. CONCLUSION

Although the treatment of fractures and nerve injuries has been well established for many years, some unanticipated sequelae of trauma, such as CRPS, had to be faced by both the patient and the doctors. This case report presents the medical community with an integrated rehabilitation regimen that, if carefully followed, may yield impressive results in the recovery of the CRPS II patient's pain, swelling, and range of motion, muscle re-education, muscle strength, and stiffness.

Acknowledgment

We would like to express our gratitude to our institute for providing the chance for this case study as well as guidance at each stage. We'd also like to thank our patients for cooperating with us and sticking to the treatment plan.

Author's contribution

All of the authors contributed to the creation of this study. SSS examined and treated the patient under the supervision of MVJ. The report was edited by TL and SL, and the final review was done by the PAP.

Informed consent

After adequately describing the purpose, the patient provided both written and oral consent. All images in this report were taken with the patient's agreement.

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Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Bawiskar D, Bais A, Naqvi W, Sahu A. Physiotherapy Approach towards a Typical Case of Injection Induced Radial Nerve Palsy Presenting as Wrist Drop. J Evol Med Dent Sci 2020; 9:1722–4. https://doi.org/10.14260/jemds/2020/378.
2. Bumbaširević M, Lešić A, Bumbaširević V, Čobeljić G, Milošević I, Atkinson HDE. The management of humeral shaft fractures with associated radial nerve palsy: a review of 117 cases. Arch Orthop Trauma Surg 2010; 130:519–22. https://doi.org/10.1007/s00402-009-0951-4.
3. Kemler MA, Rijks CPM, de Vet HCW. Which patients with chronic reflex sympathetic dystrophy are most likely to benefit from physical therapy? J Manipulative Physiol Ther 2001; 24:272–8. https://doi.org/10.1067/mmt.2001.114364.

4. Kurt KN, Akpinar P, Özkan FÜ, Aktaş İ. Complex Regional Pain Syndrome: Two Case Reports. Bosphorus Med J 2016; 3 (3): 109-112.
5. Phansopkar P, Athawale V, Birelliwar A, Naqvi W, Kamble S. Post-operative rehabilitation in a traumatic rare radial nerve palsy managed with tendon transfers: a case report. Pan Afr Med J 2020; 36.
6. Sibtain F, Khan A, Shakil-ur-Rehman S. Efficacy of Paraffin Wax Bath with and without Joint Mobilization Techniques in Rehabilitation of post-Traumatic stiff hand. Pak J Med Sci 2013; 29:647–50.
7. Stanton-Hicks M. Complex Regional Pain Syndrome: Manifestations and the Role of Neurostimulation in Its Management. J Pain Symptom Manage 2006; 31:S20–4. https://doi.org/10.1016/j.jpainsymman.2005.12.011.
8. Watson HK, Carlson L. Treatment of reflex sympathetic dystrophy of the hand with an active "stress loading" program. J Hand Surg Am 1987; 12:779–85. https://doi.org/10.1016/S0363-5023(87)80069-2