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Case Report

Physiotherapy Management Following Surgical Neurolysis for a Peroneal Nerve Injury: A Case Report

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Abstract: The peroneal nerve becomes superficial near the head of the fibula, increasing its exposure to injury mechanisms. There is a need to improve knowledge on the influence of physiotherapy on peripheral nerve injury rehabilitation. The case involves a woman with 47 years who suffered a cut in the region of distal third of right common peroneal nerve. This injury resulted in the loss of sensitivity, strength, foot drop, and neuropathic pain after suturing. These symptoms persisted for six weeks, and she had to undergo surgery six weeks after the accident. Physiotherapy was initiated 1 month after the surgical intervention, incorporating manual therapy, electrical stimulation, functional and aerobic exercise, and patient education. The patient experienced sensory alterations, pain was eliminated, and functional recovery of gait and running was achieved. However, there were residual weaknesses in hallux extensor and dorsiflexors. This case study contributes to the development of peroneal nerve rehabilitation interventions.

Keywords: Peroneal Nerve; Rehabilitation; Physiotherapy; Exercise; Foot Drop; Case Report.

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1. Introduction

Peripheral nerve injuries can result from various mechanisms, including bone fractures, dislocations, iatrogenic causes, excessive stretching, cutting, perforation, compression, vibration, thermal or electric shock, and, less commonly, radiation [1–3]. Injuries are more prevalent in the upper limb than in the lower limb [1]. According to their severity, the lesions can be classified as neuropraxia, axonotmesis and neurotmesis [4]. Lesions classified as neuropraxia are usually caused by compression and there is continuity of the nerve, and there may be changes in the myelin sheath. In the case of axonotmesis lesions, there may be discontinuity of the myelin sheath, epineurium and the axon itself, with only the endoneurium being preserved. The most serious injury, neurotmesis, involves the disconnection of the axon and all the layers of the nerve [1, 2].

Nerves regenerate via activation of silent pathways (collateral sprouting) or regenerative sprouting (axonal growth). If only the myelin layer is damaged, remyelination restores the nerve's ability to transmit impulses [5, 6]. When the injury affects more than 90% of the nerve axons, regenerative sprouting is the primary form of repair and recovery. The processes of Wallerian degeneration, axonal regeneration and reinnervation of the neuromuscular junction are involved [2]. This process is slow, with nerve growth being about 1mm per day, and lesions in which the tops of the lesion are farther away have a worse functional prognosis [7].

The best surgical and rehabilitation procedures after peripheral nerve injury have been debated [8]. Physiotherapy intervention includes Neuromuscular Electrical Stimulation (NMES), joint mobilization and therapeutic exercise, in particular aerobic exercise. In animal and human's studies, aerobic exercise has shown correlation with muscle stimulation, nerve regeneration, and neurotrophic factors production with an important role in neuroprotective processes and neuroplasticity [7, 9–11]. Peripheral nerve injuries affect the central nervous system, highlighting the importance of physiotherapy in preventing harmful adaptations [5]. Physiotherapy intervention could have more benefits if it started 4 weeks after the lesion with low intensity [11]. However, the mechanisms of peripheral nerve regeneration and the effectiveness of physiotherapy treatments are not fully understood. Some professionals prefer a 'wait and see' strategy, especially for neuropraxia cases [12] while physiotherapy is recommended for more serious cases [8]. Facing a common peroneal nerve injury, we have chosen to establish a physiotherapy intervention protocol with NMES, aerobic exercise and motor learning activities to accelerate motor, sensory and functional recovery [7–9, 13].

2. Case Report

This case report describes a 47-years-old female patient who reported good general health prior to the accident. She maintained a physically active and engaging in three weekly training sessions of moderate to vigorous intensity. She weighs 69 kg and is 168 cm tall. The patient does not report any other health problems, having quit smoking 14 years ago. She suffers an accident at home and the fall of a glass on her right leg caused a deep cut in the popliteal area of the right lower limb. According to the patient, in the moments after the accident, the activation of the dorsiflexor and extensor muscles of the fingers was maintained, despite feeling paresthesia below the level of injury. The patient went to the emergency department of the hospital and was indicated to be sutured (Figure 1).

Figure 1. Timeline of the case study.

During suturing, felt a very intense electric shock sensation, followed by foot drop. In the following hours, patient observed an exacerbation of pain sensations (10/10, Pain Numeric Rating Scale), maintaining paralysis of the right foot in the movements of dorsiflexion, eversion of the ankle and extension of the toes. The patient went to the emergency department twice, mainly due to pain, and was prescribed medication for analgesia increasingly stronger (Dexketoprofen; Skudexa; Gabapentin) but without results in pain relief. We did not receive any report indicating an iatrogenic lesion caused by the surgical suture. To the best of our knowledge, iatrogenic injuries to the peroneal nerve are most cassociated with orthopaedic procedures. However, in this case, the lesion appears to have occurred during the suturing phase, suggesting a less typical mechanism of injury [14].

The symptoms persisted for a period of five weeks, after which the patient sought consultation with a neurosurgeon at a private hospital. Electroneuromyography (ENMG) revealed a severe axonal lesion of the right common peroneal nerve, located distal to the branching point of the short head of the biceps femoris and proximal to the origin of the branch supplying the tibialis anterior muscle. No measurable motor responses were obtained from the extensor digitorum brevis or tibialis anterior muscles, and no sensory action potential was recorded from the deep peroneal nerve. Needle electromyography demonstrated abundant spontaneous activity in the tibialis anterior and peroneus longus muscles, with complete absence of voluntary motor unit activation. Conduction studies of the superficial peroneal nerve were within normal limits, consistent with preservation of cutaneous sensation over the dorsum of the foot.

After six weeks the patient underwent an intervention in the specialty of neurosurgery at a private hospital, in which fibrosis was identified surrounding the common peroneal nerve and consequent neural compression. According to the report of the neurosurgery service: "During surgical exploration of the distal segment of the right common peroneal nerve, an extensive area of perineural fibrosis measuring approximately 3–4 cm was identified. Circumferential neurolysis (360°) was performed, resulting in complete release of the nerve from fibrotic adhesions and restoration of its mobility. Haemostasis was achieved, and an anti-fibrotic agent was applied to the surgical site. The wound was closed in anatomical layers". The case study timeline is shown in Figure 1.

In the initial observation, the patient was walking with two crutches, using four points of contact, three times, with a right foot drop, and showing evident compensation of hip and knee flexion to take a step forward (Figure 2). The reason for using two crutches was due to fear of falling. Although there were no changes in balance. The patient scored 56 points on the Berg Balance Scale.

Figure 2. First assessment of walking pattern.

Weaknesses of the right gluteus Medius muscle (grade 4/5 muscle testing according to Daniels and Worthingham's Muscle Testing Techniques 15 were noted at the proximal level. Also exhibited no muscle strength in the tibialis anterior, long and short peroneal muscles, and extensor hallux. There was a slight movement in the common extensor digitorum test, graded as 1 (Table 1).

Table 1. Strength obtained by Muscle Testing.

Muscle Testing	**Right**	**Left**
Anterior Tibialis	0	5
Peronealis	0	5
Common Extensor Digitorum	1	5

Hallux Extensor	0	5

The patient experienced analgesia, anaesthesia and altered thermal sensitivity in the sensory regions of the deep peroneal nerve, i.e. dorsal and lateral hallux, and dorsal and medial aspect of the second toe. The patient reported intermittent pain (3/10) in the region of the lateral malleolus, which was difficult to locate, occurred in the morning, was non-irritative, non-severe, and unresponsive to mechanical stimuli. Neuropathic pain was considered possibly associated with the tissue regeneration process14. There were no proprioceptive changes. Hypotonia of the dorsiflexors was observed. The triceps sural muscle was hyperactive, leading to a reduced range of motion in the ankle joint, with passive movement limited to 13º and plantar flexion of 55º (Table 2).

Table 2. Ankle Range of Motion.

Range of Passive Motion Ankle	Right	Left
Dorsiflexion	13º	20º
Plantar flexion	55º	50º

Patient goals and expectations were questioned. The recovery of the dorsiflexion movement, being able to walk on the street, and return to the gym, was the patient focus. Table 3 shows the patient's life expectancy according to International Classification of Functioning, Disability and Health.

Table 3. Patient's life expectancy according to International Classification of Functioning, Disability and Health.

Classification	Domains
s199.8518	Structure of the nervous system, unspecified
b298.4	Sensory functions and pain, other specified
b730.4	Muscle power functions
b735.4	Muscle tone functions
b755.2	Involuntary movement reaction functions
b770.2	Gait pattern functions
d4500.2	Walking short distances
d4501.3	Walking long distances
d4600.1	Moving around within the home
d4751.2	Driving motor vehicles
d9201.3	Sports
e1151+1	Products and technology for personal use in daily living (e.g., crutches)

Based on the initial physiotherapy assessment, professional experience, and recent scientific evidence, three intervention phases were established. In the first phase, the intensity was lower to avoid damaging the neural regeneration process. An attempt was made to improve the condition of the scar tissue cicatrisation that occupied on the lateral popliteal area, the region of the lateral hamstring tendon, the external surface of the peroneus head, and the upper lateral third of the right leg. Massage and mobilization techniques were used [16]. The intervention aimed to improve the muscular condition of the denervated muscles, improve the condition of the proximal stabilizer muscles and the core, to prepare the patient for activities on the ground. Joint mobilization in this first phase aimed to increase the joint range of motion for dorsiflexion with the knee with 20º of flexion supported by a rolled towel to avoid stretching the peroneal nerve [17].

The movements were performed slowly and prompted voluntary activity from the patient. To perform sensory stimulation, materials with different textures were used, and for thermal re-education, tubes were used for this purpose. The stimulus was offered in a nearby region, an interval of five seconds was given, and then the stimulus was performed on the sensory region of the peroneal nerve for five seconds with slow passages. A new interval of 5 seconds was given, and the procedure was repeated [18].

We used NMES over Tibial anterior with an intensity that promotes muscle contraction. There are several types of rehabilitation protocols in which stimulation intensity must ensure sufficient muscle contraction to support functional activity. Frequency typically ranges between 10 and 70 Hz, 5 seconds on and 10 seconds off, with session durations varying from 10 to 30 minutes. In this case, we opted for a 10-minute protocol, aiming to stimulate muscles with tonic characteristics, which allowed for a high number of repetitions and aligned with the principles of motor learning and endurance training [19, 20]. The patient was asked to perform the dorsiflexion movement when the stimulation was active. Muscle strengthening exercises were also performed [7, 11, 21].

In the first two weeks, the exercises were performed with 3 sets of 12 repetitions without reaching fatigue, and the goal was to adapt the patient to the effort and develop motor control. From the third week onwards, we progressed in the difficulty and load of the exercises so that the person feels fatigue in the last two repetitions of the 12 repetitions prescribed [22]. It was also an important phase in terms of education about the injury and therapeutic activities to carry out at home. We advise walking without crutches but using a foot-up device to walk in the streets and to participate in normal day-to-day activities. Patients were advised to walk home barefoot and without support products to increase sensory input, proprioceptive feedback, and lead to a better motor response.

In the second phase, 6 weeks after starting Physiotherapy, we use Proprioceptive Neuromuscular Facilitation (PNF) to enhance dorsiflexion contraction [23], the core and lower limb strengthening exercises started to be performed on the ground, and the electrical stimulation was changed to Functional Electrical Stimulation (FES) with the performance of the step forward and step back. There is no evidence that functional electrical stimulation (FES) is superior to neuromuscular electrical stimulation (NMES) in the context of peripheral nerve rehabilitation. Nevertheless, from the perspective of enhancing the meaningfulness of exercise, increasing patient adherence, and providing both sensory afference and motor training, FES may contribute to cortical reorganization and facilitate functional re-learning [24]. Moreover, it represents an approach that is more closely aligned with the functional exercises planned for this rehabilitation process. During this phase, gait training was performed on a low-intensity treadmill, allowing manual facilitation of dorsiflexion of the right foot [7, 9, 11, 21]. In this phase we use balance exercises with reduced base of support and unstable surfaces (Figure 3).

Figure 3. Balance training on an unstable surface.

At this stage education was reinforced with the advice to return to the gym to perform upper limb strengthening, core, and lower limb strengthening exercises, 45 min., 2 times a week. In the third phase, approximately 17 weeks after beginning physiotherapy, already with functional strength in the dorsiflexors and evertors muscles, NMES was maintained in the Hallux extensor, increasing the intensity of the strengthening exercises and gait training on the treadmill (table 4) with a frequency of 2 times a week. At this stage, patient kept a gym routine 3 times a week [11, 21]. A total of 40 sessions were held. The summary of the intervention is presented in Table 4. The patient was informed about the development of the study and that it would be proposed for publication. She agreed to take part and gave her written consent. The study followed the ethical guidelines established by the Declaration of Helsinki.

Table 4. Summary of the intervention.

Interventions	Phase I (3x/w)	Phase II (3x/w)	Phase III (2x/w)
Scare mobilization	Effleurage and Petrissage		
Ankle Mobilization	Ankle dorsiflexion, plantar flexion, eversion and inversion. Triceps Sural: contract relaxing technique, 3x8 rep.	Ankle dorsiflexion, plantar flexion, eversion and inversion. Triceps Sural: contract relaxing technique 3x8 rep.	-----------
Strengthening of Stabilizing Muscles and Core	Unilateral Bridge: 3 x 12 rep. Side Lying Hip Abduction: 3x12 repetitions with 2kg free weights Abdominal Curls: 3 x 12 rep.	PNF, rhythmic initiation, D2 Flexion 3 x 12 rep	-----------
NMES in the Anterior Tibialis	NMES – 45Hz ǀ Work Cycle: 5s:10s ǀ Pulse: 100-300µ ǀ Pulse Frequency: 100 ǀ Total Time: 10min. ǀ Wave Form: Regular Monophasic	-----------	-----------
NMES in the Hallux Extensor	NMES – 45Hz ǀ Work Cycle: 5s:10s ǀ Pulse: 100-300µ ǀ Pulse Frequency: 100 ǀ Total Time: 10min. ǀ Wave Form: Regular Monophasic.	-----------	NMES – 45Hz ǀ Work Cycle: 5s:10s ǀ Pulse: 100-300µ ǀ Pulse Frequency: 100 ǀ Total Time: 10min. ǀ Wave Form: Regular Monophasic
Functional Electrical Stimulation in the Anterior Tibialis	-----------	NMES – 45Hz ǀ Work Cycle: 5s:10s ǀ Pulse: 100-300µ ǀ Pulse Frequency: 100 ǀ Total Time: 10min. ǀ	-----------

		Wave Form: Regular Monophasic Step forward and backward when on.	
Functional Strengthening	-----------	Balance Training: unipedal and unstable surfaces 3x30 seconds; total 5 minutes.	------------
Treadmill	------------	2,7km/h with facilitation 20 min.	3,0km/h-5,0km/h 30 min.
Education	Walking without crutches, using a box outside, and walking barefoot at home. Aim for 150 minutes of aerobic activity per week	Use boxia outside and walk barefoot at home. Do 3x12 squats. Use a yellow TheraBand for dorsiflexion and eversion exercises. Aim for 150 min. of aerobic activity per week	Walking without support, 12 sets of 3 squats, 3 sets of 12 repetitions with a yellow TheraBand for dorsiflexion and eversion and gym exercises to return to activity and participation

2.1 Outcome and Follow-Up

The patient fully recovered her gait function, being able to walk and run without any changes in the motor pattern (Figure 4) which is in line with the study by Pang et al [8].

Figure 4. Walking pattern with dorsiflexion.

In this study involving 34 patients with peroneal nerve damage and moderate to severe impairment of motor and sensory function, the group recovered function between 24 weeks and 41 weeks after surgery. In the present case, functional recovery of the dorsiflexor muscles occurred more rapidly, within approximately 17 weeks, facilitating a more efficient gait pattern and positively influencing the patient's engagement in daily activities and social participation. This improvement is linked to the recovery of motor function in the tibialis anterior, ankle evertors, extensor digitorum, and extensor hallucis and improved tibiotarsal range of motion (Table 5, 6).

The neuropathic pain has been completely resolved. Sensory alterations, including hypoesthesia, altered thermal sensitivity, persisted but did not affect the functional profile. Nonetheless, the persistence of sensory deficits and reduced strength in the extensor hallucis longus underscores the importance of timely intervention to prevent permanent nerve damage. In this case, neurolysis played a decisive role in restoring a favorable environment for neural regeneration, without which the structures involved would have remained at risk. The patient was discharged from physical therapy after completing a total of 40 sessions over 26 weeks, with all objectives successfully achieved.

Table 5. Strength obtained by Muscle Testing Final Results.

Muscle Testing	**Right**	**Left**
Anterior Tibialis	5	5
Peronealis	4	5
Common Extensor Digitorum	5	5
Hallux Extensor	3+	5

Table 6. Ankle Range of Motion Final Results.

Range of Passive Motion Ankle	**Right**	**Left**
Dorsiflexion	16º	20º
Plantar flexion	52º	50º

3. Discussion

This case should be interpreted in the context of post-surgical recovery following a severe axonotmesis-type lesion of the right common peroneal nerve. It is well established that the longer a nerve remains under harmful conditions, the greater the risk of developing irreversible damage [21]. The neurolysis procedure was the pivotal intervention, enabling neural regeneration by relieving perineural fibrotic compression and restoring nerve mobility. Following this, we developed a structured physiotherapy program aimed at optimizing functional outcomes and supporting neuromuscular recovery. Following the surgical neurolysis, the physiotherapy program focused on restoring functional capacity through a progressive, multimodal approach.

Despite an initial period of neural compression lasting approximately six weeks, early post-surgical physiotherapy interventions, including manual therapy, neuromuscular and functional electrical stimulation (NMES and FES), functional strengthening, and aerobic exercise, may have facilitated neuromuscular recovery, enhanced motor control, and improved functional performance during the expected phase of physiological recovery following neurosurgical decompression [2,7,9]. A follow-up electromyography (EMG) study was not performed to confirm neural regeneration. This limitation was beyond the control of the authors, as the decision to repeat electrodiagnostic testing falls under the responsibility of the attending medical team.

One of the most interesting observations in this case report is the discrepancy between the patient's good performance in balance tasks and her persistent fear of falling. Despite achieving a perfect score on the Berg Balance Scale, the patient continued to rely on two crutches due to a perceived risk of falling. "I was afraid of falling during the exercises, the imbalance was real." This phenomenon may be explained by sensory alterations and a subjective perception of incapacity, which can influence postural control. It highlights the importance of the bidirectional relationship between the peripheral and central nervous systems [5,25]. In other words, peripheral nerve injuries may lead to central adaptations or compensations, affecting sensory integration and motor planning [5]. The presence of fear of falling, despite preserved functional capacity, underscores the need for rehabilitation approaches that address not only physical recovery but also psychosocial and perceptual factors, promoting confidence and autonomy in mobility, which is reinforced in this case report [2,5].

The therapeutic plan aimed to sustain corticospinal and reticulospinal tract activation, preventing cortical and spinal disuse adaptations and facilitating reinnervation processes. Distal nerve injury frequently induces proximal compensatory patterns; these were systematically identified and addressed through targeted motor control and strengthening exercises, with the goal of restoring near-normal motor function and minimizing maladaptive adaptations [5]. Although the scientific evidence on post-operative peripheral nerve rehabilitation remains limited and heterogeneous, several studies highlight the importance of early and task-oriented physiotherapy to enhance functional recovery after nerve repair [16]. Contrary to the "wait and see" approach sometimes suggested for neuropraxic injuries, active rehabilitation, integrating graded exercise, electrostimulation, and sensory re-education, provides physiological and metabolic stimuli that may facilitate neural plasticity and regeneration [2,7,9,16].

4. Conclusion

This case highlights the importance of implementing a structured and early post-operative physiotherapy program with the potential to optimize neural recovery processes at both peripheral and central levels. The intervention appears to have contributed to improvements in motor and sensory function, as well as to the restoration of functional independence, in parallel with the expected neural regeneration period. These findings underscore the need for more detailed and standardized physiotherapy programs and further research to evaluate their effectiveness in the rehabilitation of peripheral nerve injuries.

This case report presents several limitations that should be acknowledged. First, the absence of follow-up electromyographic studies limits our ability to objectively assess the extent of the nerve injury and the progression of neural regeneration. Although a single EMG was performed, it does not provide sufficient longitudinal data to evaluate the neurophysiological recovery process. Second, detailed information regarding the etiology of the injury and the specifics of the surgical procedure was not available, which constrains the clinical interpretation and generalizability of the case.

Third, standardized functional outcome measures and quality-of-life assessments were not applied, preventing a comprehensive evaluation of the impact of physiotherapy on broader dimensions of recovery. Finally, monitoring the patient's physical activity levels throughout the rehabilitation process would have added valuable insight into behavioral adaptations and the relationship between activity engagement and functional improvement.

5. Patient Testimony

"When I first arrived at the physiotherapy sessions, I felt extremely debilitated. My right foot had a nerve injury — I couldn't lift my foot or toes. Mentally, I could imagine the movement, but physically, nothing happened. I was using crutches because I couldn't walk, and emotionally, I was devastated… frustration took over.

During physiotherapy, they used techniques to activate the muscles. My mind tried to help, I had the will, but nothing worked! I was afraid of falling during the exercises — the imbalance was real. I felt sad and told the physiotherapist I just wanted to get better. He saw my despair.

When he suggested using the Foot-Up (Boxia), which helped me lift my foot while walking, I started to see a light at the end of the tunnel… It was a very important technique for me — it gave me independence. I began walking with more confidence and less fear, and I even started driving again.

However, all the techniques and exercises I did in physiotherapy contributed significantly to my recovery. My toes started to move, I could lift them, and when walking on the treadmill, my *foot was lifting again… My balance improved, and the fear began to fade! I'm so grateful I insisted and managed to get my foot back to 100%. Today, I even go running!"* — Patient of this study

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