SRYAHWA PUBLICATIONS

Journal of Zoological Research
ISSN: 2637-5575 | Volume 7, Issue 1, 2025
https://doi.org/10.22259/2637-5575.0701002

CASE REPORT

Physiotherapy and Rehabilitation Process Applied to a Geoffroy's Marmoset Callithrix geoffroyi After Lumbar Vertebrae Fracture

Rocío Canales[1], Jordi Aguiló-Gisbert[2], Mireia Mainez[3], Emanuelle Rodríguez[1], Ana Martín[1], Carla Álvarez[1]

[1]*Mundomar, Sierra Helada s/n, Benidorm 03503, Spain.*
[2]*Servicio de Análisis, Investigación, Gestión de Animales Silvestres (SAIGAS), Veterinary Faculty, Universidad Cardenal Herrera-CEU, 46113 Valencia, Spain.*
[3]*Centro Veterinario La Marina Exóticos. Calle Santiago Pérez Aracil 30, 03203 Elche, Spain.*

Received: 23 April 2025 Accepted: 13 May 2025 Published: 22 May 2025

Corresponding Author: Rocío Canales, Mundomar, Sierra Helada s/n, Benidorm 03503, Spain.

Abstract

This article outlines the physiotherapy management and rehabilitation of a Geoffroy's marmoset (*Callithrix geoffroyi*) presenting hindquarter paralysis due to a lumbar vertebrae fracture. Training was needed to desensitize touch and manipulation before physiotherapy was initiated. The purpose of physiotherapy was to improve patient´s quality of life by enhancing mobility, muscle strength, coordination, promoting enough autonomy to re-engage his social group. These goals helped guide the rehabilitation process, aiming to maximize recovery considering animals' welfare throughout. The physiotherapy regimen included the basic principles of rehabilitation such as manual therapy, physical therapy and environmental modification. This article describes the process followed in each stage, as well as the patient´s subsequent evolution.

1. Case Presentation

An eleven-years old male Geoffroy's marmoset (*Callithrix geoffroyi*) was presented with acute onset of hindquarter paralysis. Lumbar vertebral fracture (L2) with no displacement was diagnosed by x-rays and confirmed by computed tomography (CT) scan. Although it is unknown how this injury occurred, an accidental fall from an elevated perch within its enclosure was suspected. To perform a neurological assessment (Snow et al. 2017) and evaluate the extent of neurological damage, the individual was manually restrained challenging interpretation of results. Most important findings included loss of bladder control with overflow incontinence, absence of proprioception, seriously diminished patellar reflex and withdrawal reflex, and little response to deep pain on posterior limbs. The slight presence of patellar reflex and deep pain sensation indicated that although there was a severe lesion, the integrity of spinal segment was not fully compromised.

The marmoset was placed in a small, padded recovery enclosure to minimize movement and prevent further injury (48x31x31cm). Conservative management was considered for one month to allow this aligned fracture to heal and re-evaluate neurological impairment.

In addition to immobilization and limited activity, medical treatment consisted in preventive antibiotic, pain management and nutritional care ensuring a balanced diet to support bone health and overall recovery.

By the end of the four-week repose period, x-rays and CT scan were repeated. The fracture showed signs of healing with no displacement. Neurological assessments showed some improvement on deep pain response and patellar reflex. Proprioception and

Citation: Rocío Canales, Jordi Aguiló-Gisbert, Mireia Mainez, *et al*. Physiotherapy and Rehabilitation Process Applied to a Geoffroy's Marmoset Callithrix geoffroyi After Lumbar Vertebrae Fracture. Journal of Zoological Research. 2025; 7(1): 6-10.

urination control was absent. Although no voluntary movement of the hind limbs was observed, tail movement significantly improved.

A physiotherapy program was needed to increase this patient´s recovery options. As a result of immobilization, the specimen suffered marked joint stiffness and muscular atrophy, characterized by shortened muscles and a loss of elasticity. Here the physiotherapy and rehabilitation process used for this marmoset is presented.

This individual was not desensitized to human handling, but during the four weeks of confinement, we worked on his tolerance and confidence (Brown 2012), getting to accept food from our hands, eating from a syringe and even touching posterior limbs.

But to ensure successful rehabilitation and minimize stress and anxiety levels, voluntary participation in the physiotherapy sessions by positive reinforcement training and gradual acclimatization to therapy was required to help mitigate these challenges.

2. Training Program

The training program consisted of operant conditioning using positive reinforcement (Stevenson and Rylands 2022).

Training sessions took place in a quiet, distracting-free area to help this animal to gain confidence and focus on the session.

A tasty porridge feed with syringe was chosen as reinforcer and was no part of the daily diet (Brown 2012), but additional.

Clicker was introduced by pressing the clicker at the same time reward was given by syringe. At the same time, we introduce the command "Good". Progressively we start distancing the clicker with the treat reinforcement.

A command named "Place" was introduced to guide the animal to a certain area of the enclosure with better access for us to perform the physiotherapy.

Gradually, session time was increased. At first, when the clicker and place concepts were introduced, training session were short, lasting five to ten minutes. When physiotherapy started, training session lasted 30 minutes.

2.1 Physiotherapy Objectives

The ultimate objective of this marmoset rehabilitation was to restore its physical and psychological well-being to help the animal regain the necessary skills and confidence to interact positively with its peers, ensuring a sufficient quality of life and successful integration back into its social group by voluntarily participating in the rehabilitation process.

Therapy objectives included:

- To restore mobility.
- To maintain joint range.
- To improve afferent sensations/sensitivity.
- To regain muscle strength and endurance.
- To reeducate gait.
- To enhance stability and balance.
- To recover proprioception.

3. Physiotherapy Phases

Physiotherapy and training of this patient was limited to three people. Each physiotherapy session lasted 30 minutes and was performed three times per day.

Each phase of the physical therapy lasted one month, during which the size of the enclosure was gradually increased, and new therapies were progressively introduced as the patient's condition improved.

3.1 Initial Phase

The first month of physiotherapy the marmoset was placed in a larger padded enclosure, 100x45x45cm, to facilitate training and physiotherapy management.

Physiotherapy techniques focused on manual therapy, to work on the muscle atrophy and join stiffness consequence of the repose period. Each exercise described below in manual therapy section was performed for five minutes, three times per day. During this phase the patient condition progressed, and we observed the patient engaging to the physiotherapy sessions. At this point the patient primarily moved by using its front limbs to push itself along, dragging its hind legs behind, but proprioception, although delayed, was recovered on the right limb. Sensitivity, tail movement and movement of feet and toes significantly improved, responding better to stimuli and adjusting its posture as it continued its recovery.

3.2 Second Phase

The patient was transferred to a larger outdoor mesh enclosure 200 x 140 cm, but height was kept low, 75cm, to avoid any fall. In this phase of therapy, in small bursts of effort, it attempted to take steps with its back legs, showing a gradual improvement in mobility. However, when running, it continued to rely primarily on its front legs for propulsion. The proprioception was delayed, but there was

better awareness of both limb position. This gradual enhancement in proprioceptive feedback suggested that the nervous system was regaining function.

During the second month manual therapy continued, and exercise therapy was initiated using increased space. Wooden beams and boards were added to facilitate movement around the enclosure. During this period the patient was desensitized to physical therapy techniques that were progressively introduced.

Out of the therapy sessions, exercise was promoted through enrichment. Different textures were introduced on stepping surfaces to stimulate nervous system.

3.3 Last Phase

A new spacious outdoor enclosure, 200 x 280 cm with two-meters height, featured rocks, branches, wooden beams, hammocks, climbing ropes, and different shelters.

Physical therapy became the main component of therapy in this period. Out of the therapy sessions, exercise was greatly encouraged not only with enrichment, but also using daily diet distributed across various points throughout the facility.

Modifications to the animal's habitat, such as adding climbing structures, foraging opportunities, and interactive toys, promoted physical activity and cognitive engagement, contributing to overall rehabilitation efforts.

4. Physiotherapeutic Techniques

4.1 Manual Therapy

Manual therapy involves hands-on techniques such as massage, joint mobilization, and manipulation to relieve pain, reduce muscle tension, and enhance joint mobility. We also include here passive range of motion exercises.

Massage to warm the muscles, improve circulation and relax the extremities (Polastri et al. 2019).

Gentle Range-of-Motion (ROM) Exercises: Assisted passive movements of the hind limbs to gain joint flexibility and prevent muscular contractures. Join mobilization, along with flexion and extension helped preventing the articulation from becoming immobile, reduced stiffness and gained join tissue flexibility (Benner et al. 2019).

Stretching exercises to maintain muscle memory and preserve optimal muscle length (Riley and Van Dyke 2012). This would facilitate a quicker recovery and minimize potential aftereffects.

Soft brush was used to send stimuli to central nervous system to facilitate the arrival sensorial information (Ghazni et al. 2010).

Passive leg cycling. With the marmoset lying on it back, the paralyzed limbs were carefully mobilized simulating bicycle pedaling. This exercise promotes lower-extremity blood flow, stimulate the nervous system with active assistive exercise and improve coordinated movement (Phadke et al. 2019). This exercise allows recovery of mobility, gains strength and flexibility while avoiding impact of the joints.

Posture Training encouraging positioning minimizes spinal stress and promotes proper alignment. Exercise consisted of holding onto a branch with the arms while the therapist moved the branch up and down, to stimulate standing position (Owen 2006). During first month this was a passive movement, with no weight placed on the hind limbs. As strength was regained, the patient gradually began to place weight evenly on both hind limbs and the tail.

4.2 Physical Modalities

These techniques were introduced during the second phase of therapy and became the main component of the therapy during the last phase, especially electrostimulation.

Thermal therapy. Heat can relax muscles, reduce stiffness and promotes blood flow. Cold therapy helps constrict blood vessels, which can decrease swelling. Both therapies are effective for managing pain and were used alone or in combination depending on this individual tolerance (Malanga et al. 2015). Warm or iced gloves were used, and heat was better tolerated than cold.

Vibration enhances muscle activation leading to increase muscle strength and endurance (Thompson et al. 2014). Vibration can improve circulation, promote relaxation and help reduce pain (Corbiere and Koh 2020). Due to the small size of the patient, a handheld electrical eye beauty device with heat and vibration functions was used (TOUCHBeauty Electric eye massager).

Electrical stimulation therapy promotes muscle contraction and improve rehabilitation outcomes (Reis et al. 2022). Neuromuscular or transcutaneous electrical nerve stimulation devices using electrodes and cables were considered inappropriate in this case, as the animal could get tangled (Henea et al. 2023). Instead, an electronic acupuncture pen was securely used (MQUPIN Meridien energy pen).

4.3 Exercise Therapy, Enrichment and Environmental Modification

Exercise is essential to improve strength, flexibility, and coordination. For this individual, exercise regimens were customized based on his physical progress.

Environmental enrichment plays a vital role in physiotherapy by providing stimulating activities that encourage natural behaviors. Rehabilitation exercises included controlled physical activities such as climbing, swinging, and reaching tasks that mimicked natural behaviors and promoted functional recovery.

5. Results

After one month of repose and three months of intensive therapy, the marmoset regained hind limbs near-normal range of motion and strength and was transferred to its facility to increase physical exercise in a larger space, as well as to resume socialization with its group. The use of the enclosure was alternated between the patient and the other two individuals by rotating access to both interior and exterior spaces. One group had access to the exterior area for a specific period, allowing them to engage in activities outside, while the other group used the interior dorms. After this designated time, the groups switched, ensuring that both have equal opportunities to benefit from the different environments, spreading scents and giving time to acclimate to the presence of the newcomer. During this socialization period, physiotherapy was discontinued, promoting the patient to focus on physical exercise and socialization, as well as breaking the bond and dependency on humans.

After two months of socialization period, the patient was successfully reintroduced back to its social group. The entire process of recovery of this individual, from the onset of symptoms to full rehabilitation and reunion with its social group, was achieved in six months.

6. Conclusion

Vertebral fractures in marmosets are relatively rare but can have severe consequences to the animal's welfare depending on the extent of spinal cord injury and neurological deficits associated.

Marmosets could be affected by other skeletal disorders including metabolic bone disease, and traumatic and idiopathic bone disease. Traumatic bone fractures in marmosets are not uncommon, and can be consequences of a variety of causes such as accidental falling, fighting, iatrogenic causes, etc. Metabolic bone disease can develop skeletal deformities, fractures and paralysis of the hind limbs. Muscular atrophy, weakness and even paralysis of the hind limbs are classically reported in marmosets suffering from wasting syndrome (Stevenson and Rylands 2022).

Physiotherapy may play a crucial role in the rehabilitation of tamarins and marmosets, particularly those recovering from injury, disease, or trauma. In many cases, viable treatment options exist, and euthanasia may not necessarily be required.

Marmosets are intelligent and socially complex, which can impact their response to physiotherapy. Behavioral considerations, including stress and anxiety levels, must be addressed to ensure successful rehabilitation. Techniques such as positive reinforcement and gradual acclimatization to therapy can help mitigate these challenges.

This article presents physiotherapy techniques used during this rehabilitation process, focusing on their application in enhancing recovery, improving functional outcomes, and ensuring the overall welfare of this individual.

Acknowledgements

The authors would like to thank Rocío Díaz Iborra, from Centro Veterinario Los Montesinos and the staff of the Veterinary Hospital and Faculty, Universidad Cardenal Herrera-CEU, Valencia, Spain for their exceptional support and cooperation throughout this case.

7. References

1. Benner R.W., Shelbourne K.D., Bauman S. N., Norris A., Gray T. (2019). Knee Osteoarthritis: Alternative Range of Motion Treatment. *The Orthopedic clinics of North America 50*(4): 425–432.
2. Brown S. A. (2012). Small mammal training in the veterinary practice. *The veterinary clinics of North America. Exotic animal practice 15*(3): 469–485.
3. Corbiere T. F., Koh T. J. (2020). Local low-intensity vibration improves healing of muscle injury in mice. *Physiological reports 8*(2): e14356.
4. Ghazni N. F., Cahill C. M., Stroman P. W. (2010). Tactile sensory and pain networks in the human spinal cord and brain stem mapped by means of functional MR imaging. *AJNR. American journal of neuroradiology 31*(4):661–667.
5. Henea M. E., Șindilar E. V., Burtan L. C., Mihai I., Grecu M., Anton A., Solcan G. (2023). Recovery of Spinal Walking in Paraplegic Dogs Using Physiotherapy and Supportive Devices to Maintain

the Standing Position. *Animals : an open access journal from MDPI 13*(8):1398.

6. Malanga G. A., Yan N., Stark J. (2015). Mechanisms and efficacy of heat and cold therapies for musculoskeletal injury. *Postgraduate medicine 127*(1) :57–65.
7. Owen M. R., (2006). Rehabilitation therapies for musculoskeletal and spinal disease in small animal practice. *European Journal of Companion Animal Practice 16*:137-140.
8. Phadke C. P., Vierira L., Mathur S., Cipriano G., Jr Ismail F., Boulias C. (2019). Impact of Passive Leg Cycling in Persons With Spinal Cord Injury: A Systematic Review. *Topics in spinal cord injury rehabilitation 25*(1) :83–96.
9. Polastri M., Clini E.M., Nava S., Ambrosino N. (2019). Manual Massage Therapy for Patients with COPD: A Scoping Review. *Medicina (Kaunas, Lithuania) 55*(5):151.
10. Reis C. C. S. D., Dias L. D. C., Carvalho L. B., Junior L. B. A., Imoto A. M. (2022). Transcutaneous Nerve Electrostimulation (TENS) in Pain Relief During Labor: A Scope Review. Eletroestimulação nervosa transcutânea (TENS) no alívio da dor durante o trabalho de parto: Uma revisão de escopo. *Revista brasileira de ginecologia e obstetricia : revista da Federacao Brasileira das Sociedades de Ginecologia e Obstetricia 44*(2):187–193.
11. Riley D. A., Van Dyke J. M. (2012). The effects of active and passive stretching on muscle length. *Physical medicine and rehabilitation clinics of North America 23*(1): 51–x.
12. Snow R., Mans C., Rylander H. (2017). Neurological examination in healthy chinchillas (Chinchilla lanigera). *Laboratory animals 51*(6): 629–635.
13. Stevenson M., Rylands A.B.(2022). EAZA Best Practice Guidelines for Callitrichidae – 3.2 Edition:197-198.
14. Stevenson M., Rylands A.B.(2022).EAZA Best Practice Guidelines for Callitrichidae – 3.2 Edition:441-442.
15. Thompson W. R., Yen S. S., Rubin J. (2014). Vibration therapy: clinical applications in bone. *Current opinion in endocrinology, diabetes, and obesity 21*(6):447–453.