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Physiotherapeutic Intervention in a Patient with Spinal Cord Injury (SCI)

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Abstract

Objective: To rehabilitate the patient with Spinal Cord Injury (SCI) in their maximum motor function under the injury, by means of neuroplasticity, in order to reincorporate him/her to basic daily activities. **Methods/Statistical Analysis:** Case study based on review of clinical history, radiological studies, application of standardized scales used in the area of physiotherapy and an intervention program based on neuro-rehabilitation. **Findings:** After applying the methods of neuro-rehabilitation, the patient performs rolled ups independently, makes the transfers adopting the different postures, improves postural control, especially at the axial level, leading to a better balance. In the biped position, he/she maintains the weight discharge with support of the walker and begins the march. The wheelchair is replaced by the walker, being of great benefit to the patient after 3 years of evolution of the injury and to have abandoned his treatment. **Application/ Improvements:** After completing this case study, we conclude that the individualized treatment confirms the effectiveness of the implementation of a neuro-rehabilitation intervention program in the recovery of the motor level below the lesion, without spinal cord decompression posterior to the spinal cord injury, based on therapeutic activities of repetitive exercises with their own help from the physiotherapy, facilitating the neuromuscular rehabilitation.

Keywords: Neuroplasticity, Rehabilitation, Spinal Cord Injury (SCI)

1. Introduction

Spinal Cord Injury is a pathological process (concussion, contusion, laceration, compression or section) of any etiology (traumatic and non-traumatic) affecting the spinal cord, and may lead to alterations of neurological function below the lesion: motor, sensory and autonomic[1]. The complexity of the neurological deficit, and therefore of the resulting clinical picture, depends on the level and completeness of the lesion, the transverse or longitudinal extension of the injured tissue, and the involvement of white or gray matter[2].

With respect to etiological factors[3], trauma accounts for approximately 60% of cases of spinal cord injury in developed countries, and about 80% in developing countries, such as Colombia. Knives or gunshot wounds, with a percentage between 20% and 60%, most often cause traumas. Traffic accidents have a significant overall incidence, ranging from 12% to 63%. Height falls, sports and work accidents, and shallow-water dives generally have a lower incidence. In Colombia, [4]found 50% of cases as the main cause of injury, followed by automobile accidents with 15% and falls with 14%. These figures coincide with the study by[5], conducted in the United States (USA), which reports as the main cause of SCI in whites, African Americans and Amerindians, vehicle accidents with 52%, 50% and 82% respectively, and in Hispanics it was for facts derived from violence with 48%, followed by traffic accidents with 35%.

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Spinal Cord Injury (SCI) is a pathological process that produces alterations in motor, sensory or autonomous functions, with various psychosocial consequences for the person and his family, thus generating important processes of disability[6]. One of the great consequences of the spinal trauma is the Spinal Cord Injury (SCI), and most of the causes come from traffic accidents or occupational accidents, which in a country like Colombia is very common and is seen all the days in different parts of the national territory[7].

The pathophysiology of SCI presents primary and secondary processes during its development. Primary Spinal Cord Injury involves the initial mechanical trauma due to the transmission of energy to the spinal cord, the secondary deformity and the persistent compression due to it. In general, axonal, vascular and cell membrane disruption occurs, triggering cell death and progressive vascular changes that initiate Secondary Spinal Cord Injury, in which vascular dysfunction, edema, and ischemia produce a series of processes The release of free radicals, hydro electrolytic alterations with excite toxicity and late cellular apoptosis, resulting in a sustained period of tissue destruction[8].

The neuro-rehabilitator intervention process is important in this type of patient, since a series of exercises and methods are applied based on three phases. The first, called Preparation, handling the fascia, muscles and other soft structures, by means of mobilization of soft tissues and stretching, in order to relax and eliminate toxins from such structures. The second, called Activation, through active weight exercises, assisted in different positions, with the objective of re establishing the contractile capacities of the muscles. Finally, a third phase called Function, with exercises aimed at achieving transitions in the different postures, until reaching the main objective that is the standing, which is achieved with techniques of aquatic therapy, exercises in walking and based on the physical activity that have been actively recommended for people with Spinal Cord Injury (SCI)[9].

Physical activity improves physical fitness, functional independence and psychological well-being, and reduces risk factors for chronic diseases and secondary health problems. Especially, it has reduced the risks of Cerebral Vascular Disease (CVD), Diabetes Mellitus (DM) and Obesity, which are the most general causes of death for people with SCI[6].

The present case report is based on the Spinal Trauma of an employee of electrical work at height, who underwent a fall of 12 meters. This case study constitutes an interest in management, which involves rehabilitation through physiotherapeutic techniques used to improve the quality of life of the individual. For this, the bibliographical reviews, the obtaining of articles dedicated to the subject, as well as the physical rehabilitation and the application of evaluation instruments that, consequently, made that the patient not only improved its motor function, but also became more independent in their basic daily activities.

2. Materials and Methods

2.1 Spinal Cord Injury Patient

A case-study study was performed on a 44-year-old male patient, with Spinal Cord Injury due to work-related injury (height work), with a medical diagnosis of spinal cord injury, treated for one year with one-hour sessions three times per week. The neurological clinical picture was recorded, according to the scale of the American Spinal Injury Association (ASIA/IMSOP) resulting in Spinal Cord Injury (SCI), presenting Anterior Spinal Cord Syndrome (American Spinal Injury Association-ASIA), Level B (incomplete), Sensitive Neurological Level and Motor L4.

Based on diagnostic exams, which were first referred by the physician in the radiological study (Figure 1), axial compression fracture of more than 70% of T5 was found with posterior wedging and partial displacement towards the central canal with Chronic Myelopathy, showing incomplete medullar section, right radius distal fracture.

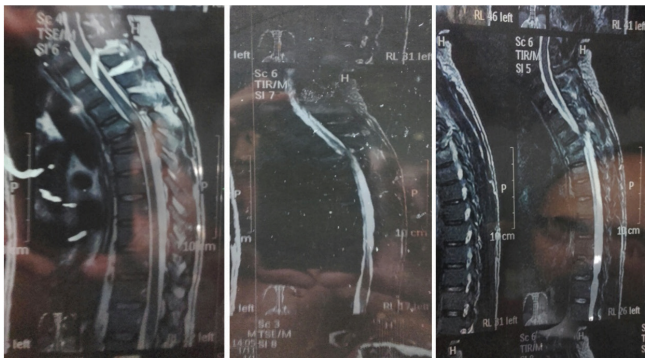

Figure 1. Patient Spinal Cord X-ray.

2.2 Clinical Findings of the Patient

Patient conscious, oriented in time, place and space, with a diagnosis of Spinal Cord Injury (SCI), with an evolution of 3 years, who enters the office in a wheelchair accompanied by his family, stating that they have abandoned physiotherapeutic treatment. For this reason, it requires a new assessment to continue with physiotherapeutic treatment.

The clinical findings, found in the general observation of the patient, were as follows: severe left lower limb edema with predominance of standing neck, fluctuating muscle tone, moderate muscle weakness, mild right lower limb muscle atrophy, moderate flexibility of the quadriceps, hamstrings, calf muscles, soleus and tibialis of the right foot, does not resist the prone position for 5 seconds, adopts with difficulty the quadruped position, standing with the aid of the walker only for 4 seconds and with the collaboration of the family relative, altered balance and coordination in different positions, moderate myoclonus to knee extension, absence of gait phases, semi-independent of daily living activities.

2.3 Evaluation

In order to initiate the appropriate physiotherapeutic treatment, diagnostic aids were used: X-ray (X-ray), computed tomography (CT), and magnetic resonance imaging (MRI).

Physiotherapeutic evaluation, based on different scales, endorsed and standardized in order to design an adequate treatment program, was performed. The following were used: Daniels Scale, American Spinal Injury Association (ASIA), Ashworth modified, and analog pain scale.

The evaluation was performed before, during and after, by a physiotherapist specialized in neurorehabilitation, who used as a tool a neurological assessment format. The postural and movement patterns, found in the neurological evaluation of the patient, are described below:

Supine Position before Treatment: Head and trunk tilted left, right and left upper limb in shoulder abduction, elbow extension and flexion of both hands, moderately globose abdomen, symmetrical hips with slight left right knee flexion, feet In planibration with heel union (Figure 2).

Figure 2. Supine Position before Treatment.

Prono Position before Treatment: Head turned to the left side without contact with the mat, elevated and abducted scapulae, tension in the scapular elevating muscles, mid and lower trapezius, right and left upper limb with adduction shoulder, flexion of elbows, forearms supported on mat with inactive hands at trunk level, tension in lumbar square, hips and extended knees. It is not able to adopt the prone position (Figure 3).

Figure 3. Prone Position before Treatment.

Quadruped Position before Treatment: Flexed head, upper limbs in extension with weight loss on the dorsum of the wrists and metacarpals, winged and separated scapulae, trunk extension, hips in adduction and flexed knees with right foot flexion and inversion in left foot. He is not able to adopt the quadruped position (Figure 4).

Figure 4. Quadruped Position before Treatment.

Sitting Position before Treatment: Head in flexion with anterior inclination, weakness in pectoral muscles and anterior rectus with weight loss in the trunk extensor muscles, generating a moderate dorsal kyphosis (flexion trunk collapse), rounded shoulders forward, pelvis in Anteroversion (Figure 5).

Figure 5. Sitting Position before Treatment.

Bipedal Position before Treatment: Maintains position only with external help. Asymmetrical hips are observed, with discharge of weight at the level of the forearms and wrists. Legs slightly apart, with slight flexion of right lower limb accompanied with heel take-off. It is observed that the largest weight loss occurs in the lower left limb (Figure 6).

Figure 6. Bipedal Position before Treatment

2.4 Physiotherapeutic Intervention

The physiotherapeutic treatment was aimed at helping the patient in the rehabilitation process, emphasizing neuroplasticity, contributing to the recovery of both motor and sensory abilities below the injury. The intervention program was divided into three phases:

- Preparation Phase
- Activation Phase
- Function Phase

Table 1 describes the Intervention Process, conducted over a year, with one-hour sessions three times a week.

Table 1 Intervention Process

PATIENT	**LEVEL OF INJURY**	**ASIA**
PATIENT	T5	B
INTERVENTION	TIME	RESULT
PREPARATION PHASE		
Mobilization of soft tissues	20 minutes 3 times per week for 1 month	Improves spasticity with myoclonus in lower limbs.

Lymphatic drainage	15 minutes 3 times a week for 1 month	Diminishes edema located in lower left limb
ACTIVATION PHASE		
Active-assisted exercises with Thera-bans, weights and weight downloads	1 hour 3 times a week	Strengthens pectoral muscles, triceps, biceps, anterior rectus, quadriceps lumbar square
Stretching exercises.	45 minutes 2 times a week	Improves flexibility, especially at the trunk level
Exercises in mat to work the transitions in position supine, prone and rolled.	1 hour 3 times a week for 2 months	It manages to perform the various positions for several minutes which it could not tolerate
Postural control through the Bobath technique	45 minutes 3 times per week	Improved trunk control and balance
FUNCTION PHASE		
Exercises in quadruped position	1 hour 3 times a week for 2 months	It is possible to strengthen pelvic muscles, gluteus maximus, psoas in order to prepare it for the bipedal position
Exercises from the quadruped to bipedal position with muscular strengthening	1 hour 3 times a week for 2 months	Achieves the transfers and strengthens quadriceps muscles, gluteus maximus.
Hydrotherapy with bad-ragaz technique, halliwick	1 hour 2 times a month	Improves balance
Exercises in bipedal position in parallel bars	1 hour 3 times per week for 2 months	Improves biped position by seconds without help and starts the ride

3. Results

After applying the Intervention Program based on neurorehabilitation, we proceeded to evaluate the outcome and evolution of the patient. The following is the progress for each of the evaluated positions:

Supine Position after Treatment: Head in neutral position, symmetrical trunk, slightly globular abdomen, upper left abduction, right upper limb in adduction, symmetrical hips with extension of lower limbs, feet in flexion of soles with separate heels (Figure 7).

Figure 7. Supine Position after Treatment.

Prone after Treatment: Head in neutral position supported on both hands with abduction of shoulders in 90 degrees of upper limbs, flexion of elbows, symmetrical hips, extension of lower limbs with feet in flexion of soles, without tension to adaptation (Figure 8).

Figure 8. Prone Position after Treatment.

Quadrant Position after Treatment: Head in neutral position, scapulae in abduction extended trunk with discharge of weight in four points (Figure 9).

Figure 9. Quadruped Position after Treatment.

Sitting Position after Treatment: Head in neutral position with strengthening of pectorals, anterior rectus and lumbar squats adopting better posture, which decreases dorsal kyphosis (Figure 10).

Figure 10. Sitting Position after Treatment.

Biped Position after Treatment: It manages to maintain the bipedal position through the discharge of weight in lumbar and gluteal squares with the support of parallel bars, heels attached to the floor, improving balance and postural control (Figure 11).

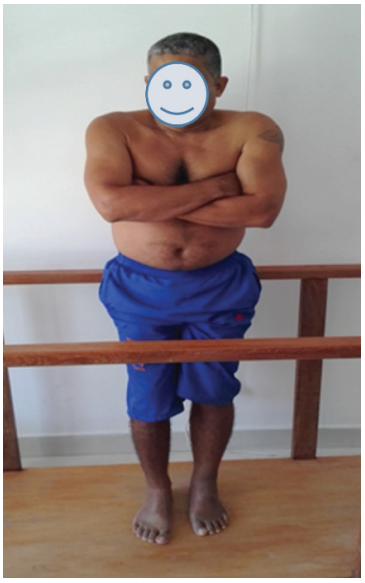

Figure 11. Bipedal Position after Treatment.

From the initial evaluation to the final evaluation, 12 follow-ups were done to evaluate the treatment plan, with the result that the patient performs independently, performs the different transfers adopting different postures, and improves postural control especially at an axial level, leading to a better balance. As for the bipedal position, it maintains the weight release with the support of the walker and starts the gait with absence of the phase of acceleration, mean balancing and deceleration, tolerating the different physiotherapeutic neuro-rehabilitation methods, used in physical rehabilitation for each Session. It is worth mentioning that the walker, which is of great benefit to the patient, after 3 years after the trauma, replaces the wheelchair.

Within the evaluation process, the patient was also evaluated by the physiatrist, who stated that the patient was in better conditions and recommended to continue with the physiotherapeutic treatment traced by the physiotherapist, in order to optimize his quality of life and be more independent in their basic daily activities.

4. Discussion

Through the Physiotherapeutic Intervention Methods, that were used in the rehabilitation traced, the results show that it had functional improvement of the activities of the daily life, among them to go to the bathroom by means of the walker without the need to use the wheelchair.

The interventions that were directed through the different activities programmed, since their evaluation,

demonstrated the positive change and the great work that fulfills the spinal automatism and the neuroplasticity in the motor recovery of the patient. This treatment is related to the article of the authors[10], where they promoted plasticity for motor and sensory recovery below the level of the spinal cord injury, carrying out the repetitive practice of the Motor tasks.

During the execution of the Treatment Plan developed with the patient, one of the objectives was to rehabilitate his motor function to the maximum extent. The patient, as well as the elongation of the retracted muscle fibers, improving significantly in the activities of the pre-march with the re-education of the coordination and the balance, recovered the strength of weak muscles. Despite the lack of scientific evidence in the management of this type of trauma, the management of the rehabilitation of Spinal Cord Injury is of vital importance, taking into account that any function that executes the spinal cord in a normal person is controlled by means of the supra-spinal centers of the Central Nervous System[11]. In case of being altered by any trauma, it unbalances the voluntary control. However, the spinal cord has an automatism where it can perform small functions below the injured point, because it has in particular a central pattern generator that helps in the rehabilitation process.

5. Conclusions

After performing the neuro-rehabilitating intervention in the patient, it was demonstrated that, through a good evaluation and an individual rehabilitation program, it is possible to obtain a positive effect in improving the patient's quality of life. It was achieved that the patient had greater functional independence through their own ability, supporting their own weight in their lower limbs and improving their postural control and balance, carrying out the stages of gait.

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