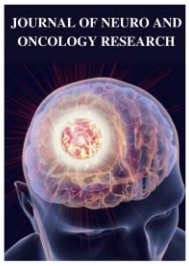

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Case Report

A Case Report on Physiotherapy Rehabilitation in Spinal Cord Injury (SCI) After Excision of Ependymoma

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Abstract

Introduction: Spinal Cord Injury (SCI) refers to damage to the spinal cord, which can result from traumatic events such as falls, traffic accidents or violence, as well as non-traumatic causes. Spinal cord injuries resulting from ependymoma space-occupying lesions represent a significant clinical challenge due to their rarity and complex presentation.

Case Description: Our patient is a 57-year-old male businessman who underwent a laminectomy surgery at C7 and T1 one and a half months ago. He came to us with complaints of being unable to transfer himself, stand or walk due to a loss of muscle function in his lower limbs. During the past 1.5 months, the patient has not received any form of physiotherapy. Examination: NPRS, Spirometer, PEFR, SCIM ASIA, FIST and WISCI scales were taken. Intervention: Patient received a tailor-made goal-oriented intervention 5 days a week where the protocol was provided for over a session of 1.5 to 2 hours.

Outcome: NPRS improved from 8 to 0, UEMS improved from 44 to 50. SCIM improved from 20 to 56, WISCI improved from 1 to 9.

Discussion: A tailor-made program for rehabilitation post ependymoma excision induced spinal cord injury is key element for a better prognosis of patient, since same size shoe cannot fit for all. Hence a therapist must rely on extensive assessment and knowledge backed up by experience in treating the patient with such rare conditions. We also conclude a felt need of low-cost mechanical paraplegic ambulatory devices. In the present scenario majority of patient in India and to our clinical experience cannot afford costly ambulatory devices.

Conclusion: A tailor-made, goal-oriented physical therapy intervention can significantly enhance the functional abilities of patients with Spinal Cord Injury (SCI) following the Post operative excision of an ependymoma.

Keywords: Spinal Cord Injury; Ependymoma Excision; Rehabilitation; Walking Index; Balance; Independency

Introduction

According to the Alzheimer's Association, a leading voluntary health organization in Alzheimer's care, support and research, Spinal Cord Injury (SCI) refers to damage to the spinal cord, which can result from traumatic events such as falls, traffic accidents or violence, as well as non-traumatic causes. SCI can lead to varying degrees of functional impairment, structural impairment characterized as complete or incomplete and can result in numerous complications affecting multiple body systems [1,2]. In India, the prevalence of SCI indicates that falls account for 53% of cases, while road traffic accidents contribute to 28% [3].

Spinal cord injuries resulting from ependymoma space-occupying lesions represent a significant clinical challenge due to their rarity and complex presentation. Ependymomas, which are glial tumors arising from ependymal cells, account for 50-60% of spinal cord gliomas and can lead to various neurological deficits depending on their location within the spinal cord [4]. The management of these tumors typically involves surgical resection, with the goal of achieving Gross Total Resection (GTR) to

minimize recurrence and improve long-term outcomes [5]. Ependymomas are classified by the WHO into grades I to III, with grade II being the most common in the spinal cord [5]. They predominantly occur in the cervical region, which can lead to specific symptoms such as back pain and motor deficits [4]. Patients often present with nonspecific symptoms, including back pain, motor weakness and sensory changes, which can delay diagnosis [6]. Complete resection is the primary treatment, with GTR associated with better outcomes [6].

This case report aims to provide a comprehensive assessment and management strategy for a rare spinal cord injury resulting from the excision of an ependymoma, which left the patient with paraplegia. The report focuses on the use of combined approaches, the involvement of family and caregivers, the dilemma of choosing a walking device or orthosis in the Indian context and the importance of achieving sitting balance during rehabilitation.

Case Description

A 57-year-old male businessman who underwent a laminectomy surgery at C7 and T1 one and a half months ago and had spinal cord injury.

History

Since 2021, the patient has gradually developed tingling and burning sensations in the soles of his feet, making walking difficult. These symptoms have progressively worsened over time. In August 2023, he consulted a neurologist, who diagnosed him with a space-occupying lesion in the spinal cord at the C7-T1 level. He was then referred to a neurosurgeon for surgical decompression and excision of the lesion.

The patient was admitted on January 24, 2024 and all necessary investigations were conducted. After confirming pre-operative fitness and obtaining informed consent, the surgery was scheduled. On January 25, 2024, the patient underwent a C7-D1 laminectomy and excision of an intramedullary mass located between C7 and D1, with intraoperative neuromonitoring performed under general anesthesia. Post-procedure, the patient was kept under observation and managed with Intravenous (IV) fluids, IV antibiotics, IV antacids and other supportive treatments. Overall, the patient's hospital stay was uneventful. The patient remained vitally and hemodynamically stable and was thus discharged with appropriate medical management (Table 1, Fig. 2).

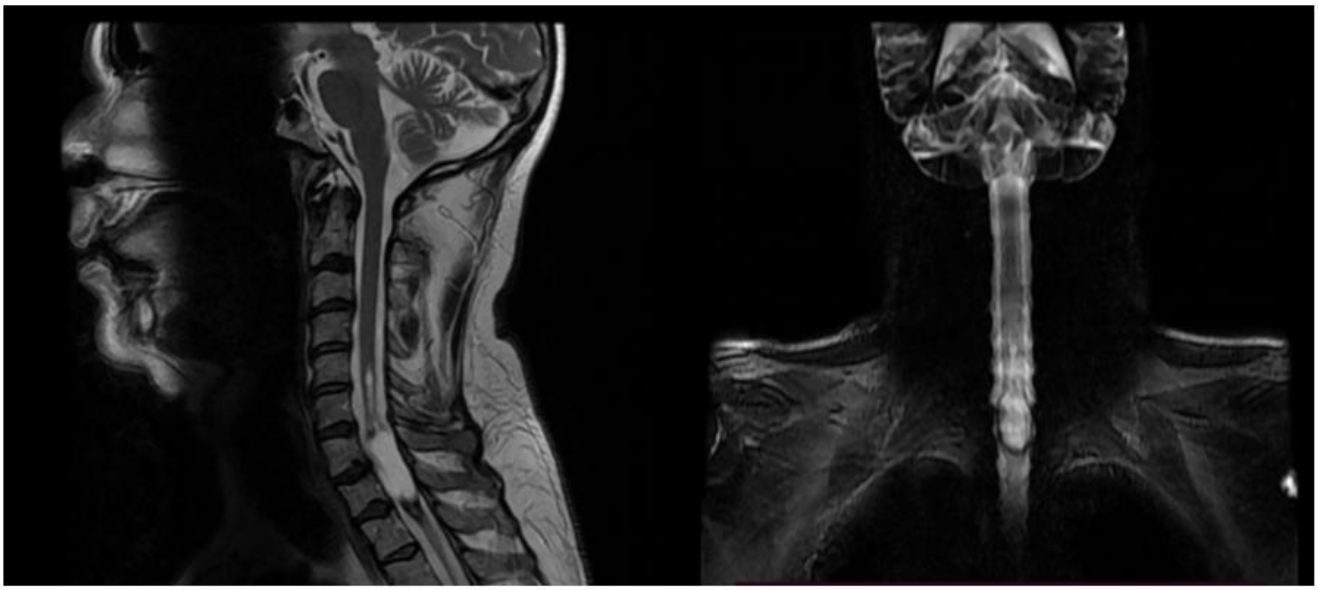
Following the surgery, the patient lost sensation and motor control in his trunk and lower limbs. He was advised to start physiotherapy after the operation; however, due to social and cultural reasons, he was unable to commence treatment. After 1.5 months (March, 2024), he came to us with complaints of being unable to transfer himself, stand or walk due to a loss of muscle function in his lower limbs. During this period, he had developed some movement in his right toe and regained some sensation in his lower limbs.

Investigation

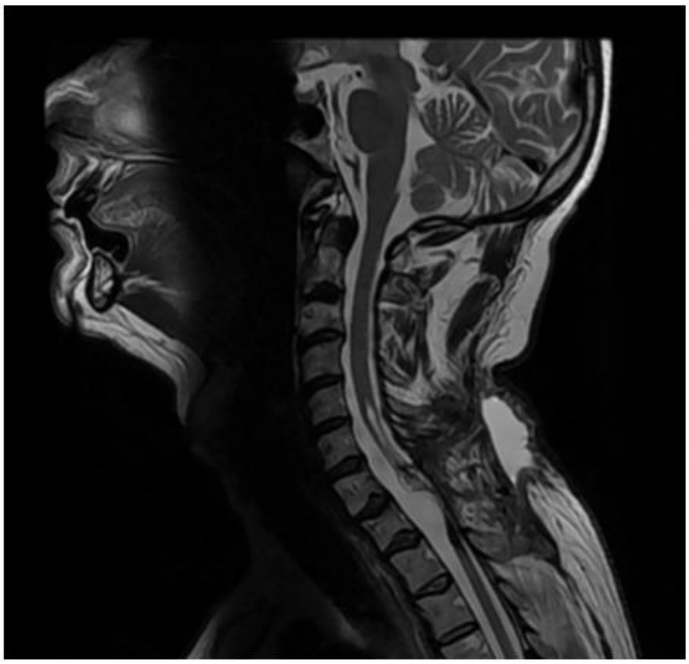
Date	Finding	Impression	Image
24th October, 2023	There is evidence of oval shaped well defined SOL in intramedullary Location of spinal cord extending from upper border of C7 to upper border of D2. The lesion is homogeneous hypointense on T1 and hyperintense on T2. It shows tapered ends with hydrosyrinx formation between C5 and C6 vertebral levels. Size of the lesion is 13x15x37mm. At the cranio-caudal edge of the lesion, there are T2 hyperintense foci representing hemorrhagic residue	Suggestion of intramedullary SOL in spinal cord extending from upper border of C7 to upper border of D2 with cranial hydrosyrinx, hemorrhagic residue at edges of the lesion as described, P/O Ependymoma. As compared to previous study done elsewhere, no obvious changes are seen.	Fig. 1
22nd January	Finding on January 2024, remains unchanged compared to previous MRI.	Impression on January 2024, remains unchanged compared to previous MRI.	-

2024			
27th April, 2024	Approx. 15x30x40 mm, VOL: 09 cc fluid signal, collection in subcutaneous plane at operated site, S/O Seroma. Between lower border of C5 to lower border of C7 vertebral levels there exists a syrinx formation of diameter 2.8mm.	‣ Post operative status, residual mild inflammatory changes at operated site in intermuscular plane extending up to dural surface. No obvious focus of tumor substance with reference to preoperative imaging. > A small seroma formation in subcutaneous plane at operated site.	Fig. 1

Table 1: MRI Finding and Impression of the patient.



A - MRI (24th October 2023) B - Myelogram MRI (24th October 2023)



C - MRI (27th April 2024)

Figure 1: MRI scans.

Examination

The patient exhibits normal cognition and perception with stable vitals. All cranial nerves are functioning normally. The spirometry test could not be tested at the 1st assessment as the subject couldn't manage to overcome the initial threshold. The Peak Expiratory Flow Rate (PEFR) is the volume of air forcefully expelled from the lungs in one quick exhalation, for the subject the PEFR was 150 L/minute. Patient reports pain in both shoulders and the lower cervical region, which intensifies during prolonged sitting and alleviates during sleep. The Numeric Pain Rating Scale (NPRS) indicates a pain level of 8 during prolonged sitting. Passive Range of Motion (ROM) was within normal limits and no tightness, deformities or contractures are observed. Reflexes for the biceps, triceps and brachioradialis are bilaterally rated at 2+ (normal). However, the knee jerk, ankle jerk and plantar responses could not be elicited. According to The American Spinal Injury Association impairment (ASIA) scale a standardized neurological examination used to assess the sensory and motor levels which were affected by the spinal cord injury suggested a total Upper Extremity Motor Score (UEMS) was 44, Lower Extremity Motor Score (LEMS) was 8, total Light Touch score (LT) was 50 and Total Pin Prick (PP) score was 68. The Spinal Cord Independence Measure Version III (SCIM-III) is reliable and valid tool for individuals with Spinal Cord Injury (SCI) to assesses performance in activities of daily living and mobility, the total score of SCIM was 20. The Functional Independence Measure (FIM) is seven-level ordinal scale widely used to assess a patient's functional independence and level of disability, the total score of FIM was 65. Over the first assessment patient couldn't achieve starting position of Function In Sitting Test (FIST), as at that time subject required assistance to maintain upright sitting. The Walking Index for Spinal Cord Injury (WISCI) is a functional capacity scale to measure ambulation in persons with spinal cord injury, the Level for WISCI was 1.

Intervention

Patient received intervention 5 days a week where the below mentioned protocol was provided for over a session of 1.5 to 2 hours.

Education

Patient and care giver were educated regarding SCI, structure and function of spinal cord, motor and sensory loss, expected outcome, complication and prognosis. Patient and care giver were also educated importance of physiotherapy and its impact on physical function and independency. Education of caregiver regarding proper handling and transfer skill was carried out to prevent secondary complication. Patient and caregiver were also educated about secondary complication and home management to prevent secondary complications. All these were carried out in first few sessions of in adjunct of physiotherapy. Over the period of time patient and caregiver were provided counseling at regular interval of 15 days, where they were motivated to ask any doubts regarding the condition or physiotherapy.

Prevention of Secondary Complication

Bed mobility exercise, ankle-toe movement and changing the position every two hours; advise to use water or air bed to reduce pressure.

To Reduce Pain

Ice pack 15 min, gentle stretching to upper trapezius and pectorals, isometric neck exercises, postural correction exercise and shoulder retractor strengthening was carried out. This was provided for 45 days after which Pain was obliterated.

To Improve Cardio Respiratory Function

Chair aerobics with frequency of 3 times per week, for 20 min, at 40 to 50% of intensity, starting from interval training at 1st 2 month and gradually increased to continuous training by 6th month to maintain and improve cardiovascular endurance. Chair aerobics consisted of upper limb movements with and without weight, with and without wand; and pedo-cycle. Breathing exercises like pursed lip breathing, thoracic expansion, diaphragmatic breathing, spirometer, sucking and blowing were performed 6 days a week to maintain and improve respiratory functions.

To Improve Mobility

Bed mobility exercise including supine to side line, side line to prone and prone to supine; and supine to sit was given on alternate days for 20 minutes in initial 3 months.

Met Exercises

Core muscle facilitation in crunches, cross crunches and back extension 10 to 15 repetition; Positioning patient in quadruped, kneel sitting and kneel standing and gradually adding sway to keep the exercise challenging. Met exercises were performed for 20 min for 2 times a week.

To Maintain Flexibility and Joint Function

Stretching to calf, hamstring, quadriceps, thoraco- lumbar fascia, latissimus dorsi, pectorals, trapezius were performed once a week. Active, Active Assisted and Passive ROM exercise were given to all the joint 10 repetition x 2 times on alternate days.

To Improve Muscle Function

Daily Adjusted Progressive Resisted Exercise (DAPRE) for upper limb muscles was given on alternate days. Lower limb PNF and trunk PNF was provided to muscle re-education.

To Improve Sitting Balance and Upper Limb Functions

Sitting with minimum support and doing functional task like reaching out scrubbing, brushing and eating were performed. Patient developed independent static sitting within 3 months. Later independent sitting and functional task with upper limb were performed in controlled environment. Gradually task was made difficult to keep the activity challenging. Later siting with eyes closed and holding upright with external perturbation was given. Progression to trunk bending and rotation, pushing and pulling in sitting were added. 20 minutes of training was provided every day.

Transfer Training

The patient was given transfer training from bed to wheelchair and wheelchair to bed, also patient was trained for wheelchair mobility skill. Where necessary, caretaker was also trained for transfer skills and for proper patient handling at home. Transfer training was provided 2 times a week for 20 min in initial 3 months. Later patient demonstrated good transfer ability and was advised to continue the same at home.

To Improve Standing Balance

Initially patient was given standing on Tilt table for 1-month, later patient was given standing with bilateral Hip Knee Ankle Foot Orthosis (HKAFO) and 2 therapist assistance, gradual progression to standing with wall bar support or walker support was made. In standing with bilateral HKAFO activities like bending anteriorly, posteriorly and laterally; pelvic circle, anterior, posterior and lateral pelvic movement were initiated and gradually progressed to meet the limit of stability and to keep the activity challenging. Standing on one leg with bilateral HKAFO and kicking was provided in later stage. 20 minutes of training was provided every day.

Gait Training

Gait training with 2-therapist assistance was initiated which was slowly progressed to independent walking with walker over the period of 9 month. 20 to 30 minutes of training was provided every day.

Outcome

Using the aforementioned intervention, the patient showed significant recovery. The shoulder and neck pain were alleviated within 40 days, providing comfort to the patient. Since the patient had a motor neurological level of C7, there was a reduction in respiratory function. However, after implementing breathing and aerobic exercises, there was notable improvement in respiratory function (as shown in Table 2), with Peak Expiratory Flow Rate (PEFR) increasing from 150 l/min to 450 l/min over the course of 9 months. Additionally, the patient's spirometer hold increased to 600 cc volume over 5 seconds.

The patient's independence also improved, as indicated by the Spinal Cord Independence Measure (SCIM) score rising from 20 to 56 and the Functional Independence Measure (FIM) score increasing from 65 to 95. Within 3 months of the intervention, the patient was able to restart his business, which was a significant relief for him as he was the sole income provider for his family. By 4 months, the patient demonstrated a higher level of self-esteem, as he could perform daily tasks with his upper limbs, such as eating and grooming and required less assistance with transfers and dressing.

As noted in Table 2, the patient experienced some deterioration in sensory and motor symptoms according to the ASIA scale at the 3-month mark. This was promptly addressed by referring the patient to a neuro-physician, who conducted the necessary investigations; it was discovered that a small syrinx (2.8 mm) was developing between C5 and C7. Proper medical care was rendered by the neuro-physician and signs of recovery were observed within a month, as reflected in the ASIA scale in Table 2. The motor score for the upper limbs improved from 44 to 50 and the lower limb score increased from 8 to 21.

Most motor recovery was noted after 7 months, which contradicted initial expectations. Sensory levels, as measured by Light Touch (LT) and Pin Prick (PP), showed some recovery in the initial months. However, symptoms likely worsened due to the syrinx, resulting in a less favorable outcome compared to the baseline, as indicated in Table 2. By the 7th month, the patient achieved a Functional Independence Screening Test (FIST) score of 14, which improved to 48 by the 10th month, suggesting good prospects for motor recovery even in chronic stages.

Walking exercises commenced using bilateral Hip-Knee-Ankle-Foot Orthoses (HKAFO) with the assistance of two therapists. Initially, the patient could walk 10 to 20 meters during the first 2 months; gradually, this distance increased to 40 meters by the 4th month and 60 meters by the 6th month. After 6 months, the patient demonstrated a significant improvement in walking control and required less assistance. By the 7th month, he was able to walk using bilateral HKAFOs and a walker with assistance from one therapist and by the 9th month, he was able to walk independently with the walker and bilateral HKAFOs.

Time	NPRS	ASIA				SCIM	FIM	PEFR	SPIROMETER	FIST	WISCI
		UEMS	LEMS	LT	PP					-	
Baseline	8	44	8	50	68	20	65	150	-	-	1
1 month	2	46	8	50	68	36	70	200	-	-	2
2 month	1	48	8	52	70	38	71	220	600 2SEC	-	2
3 month	0	48	8	44	65	40	70	240	600 2SEC	-	2
4 month	0	50	10	46	65	40	74	230	600 1SEC	-	2
5 month	0	50	10	47	64	43	77	260	600 2SEC	-	2
6 month	0	50	10	47	64	45	80	410	600 3SEC	-	6
7 month	0	50	10	47	64	45	81	380	600 4SEC	14	6
8 month	0	50	15	47	64	46	81	430	600 4SEC	33	6
9 month	0	50	18	47	64	47	85	450	600 5SEC	42	9
10 month	0	50	21	47	64	56	95	460	600 5SEC	48	9

Table 2: Patient's outcome (NPRS- Numerical Pain Rating Scale, ASIA- American Spinal Injury Association Impairment; UEMS- Upper extremity motor score; LEMS- Lower extremity motor score; LT - Light touch score; PP - Pin Prick; SCIM - Spinal Cord Independence Measure Version III; FIM - Functional Independence Measure; PEFR- Peak Expiratory Flow Rate; FIST - Function in sitting test; WISCI - Walking Index for Spinal Cord Injury).

Discussion

A tailor-made program for rehabilitation post ependymoma excision induced spinal cord injury is key element for a better prognosis of patient; after all, a one-size-fits-all approach is not effective. Hence a therapist must rely on extensive assessment and knowledge backed up by experience in treating the patient with such rare conditions. Although the prognosis for this patient

was uncertain, giving up was never an option [7].

With consideration of the patient's environment and socioeconomic background, a complete tailor-made treatment was created. Studies indicate that goal-oriented treatment yields better outcomes [7-9]. The therapist's knowledge and experience debunked the myth of relying on a singular approach, leading to the adoption of a combination or holistic approach to foster greater independence [10].

Considering the educational status, cultural background, social dilemmas and premorbid condition we recognized the potential of depression, anxiety, ignorance and withdrawal from society [11]. So, through education of condition and possible outcome were made with patient and his family. Patient and family members were also provided a regular counselling and educational sessions. All this led to a grater motivation in the patient. To our observation the patient's motivation and hope was one of the key factors for the recovery in the patient.

Due to the surgical procedure and the patient's initial inability to engage in physiotherapy, he experienced significant neck and shoulder pain. Our management was promptly able to reduce the pain and bring comfort to the patient. Pain had resolved to bare minimum (NPRS - 1) within 40 days.

A major obstacle in rehabilitation is development of secondary complication and patients' and caretakers' participation is key to prevent the secondary complication [12]. Our treatment hence forth aimed not only to provide a therapeutic session but also to involve caretaker in the sessions so as to educate them about management for prevention of secondary complication. Cardio pulmonary fitness training is a key element in prevention of secondary cardiopulmonary complication and improvement in endurance [13]. Due to our diligence the patient did not develop any kind of musculoskeletal, integumentary or cardio-pulmonary complication.

In people with SCI evidence about the effectiveness of training strategies is lacking so, we need to rely on theories of motor control built on the findings of experiments and randomised trials in similar patient and able-bodied populations [14].

Jones ML, et al., in their study suggested that Activity-Based Therapy (ABT) have sparked considerable interest in this intervention among individuals with SCI to promote neurorecovery after SCI. ABTs attempt to activate muscles below the level of the lesion, "with the goal of retraining the nervous system to recover a specific motor task. The ABT interventions used in the beyond therapy program involve 3 elements: developmental sequence activities, progressive resistance training to build strength and endurance and task-specific (locomotor) training. Developmental sequencing is focused on strengthening the primary stabilizing muscles of the trunk and pelvis because of their central role in core stability; this approach involves training in various positions thought to contribute to the attainment of upright function and walking. These include activities performed in quadruped (on all fours), kneeling, sitting and standing positions. Participants in their experimental group evidenced an average increase of 5.1 ± 6.3 in total motor scores and 4.2 ± 5.2 in LEMS [15].

Rodríguez LS, et.al., stated the interventions that were directed through the different activities programmed, since their evaluation, demonstrated the positive change and the great work that fulfils the spinal automatism and the neuroplasticity in the motor recovery of the patient. Authors, also suggested that 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. 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 [16].

Our robust management included patient's goal cantered approach, inclusion of functional task, motor control theories and theories of neuroplasticity. Our patient demonstrated improvement in UEMS from 44 to 50; and LEMS from 8 to 21. Harness, et al., reported an average increase of 4.8 points in total motor score and of 3.3 points in LEMS in a sample of 21 individuals with SCI who participated in 6 months of intensive activity-based therapeutic exercise [17]. SCIM score improved from 20 to 56 and FIST improved up to 48 in the patient since the treatment included functional task where ever possible.

Neurologically intact muscles of a person with SCI would respond to strength training similarly to than the muscles of an able-bodied person. The upper limb strength training program person with paraplegia aimed at improving the ability to lift from the floor to a wheelchair needs to follow the same principles of strength training as would be applied to an able-bodied person [14]. Training was performed within the context of a functional skill using the principals of DAPRE.

Despite the advancement of technology in paraplegic ambulation, in developing countries the cost of treatment exceeds the affordability. Considering the economic status of the patient, we opted for use of a bilateral HKFO for rehabilitation. WISCI improved from 1 to 9 in the patient. Although the goal is to restore functional ambulation, few paraplegics are able to meet current definitions of functional ambulation. Although the ability to ambulate functionally using HKAFO devices is still a topic of debate, it is generally agreed that, in the paraplegic population, walking is slow and laborious [18].

We thereby conclude a felt need of low-cost mechanical paraplegic ambulatory devices. In the present scenario majority of patient in India and to our clinical experience cannot afford costly ambulatory devices.

Previous studies have noted that the time it takes to receive injury care and medical attention is influenced by cultural beliefs, income and education [19]. In this case, multiple factors led to a delay in the commencement of physiotherapy for the patient, which began approximately 1.5 months later. These factors included economic instability at the time of surgery, the patient's belief that bed rest would cure their weakness and the fear that exercising would worsen their condition.

Based on the author's experience, early initiation of physiotherapy following Spinal Cord Injury (SCI) results in better improvements in independence and quality of life. However, it should be remembered that "better late than never," as there is always the possibility of improvement with medical and paramedical attention at any given time.

Conclusion

A tailor-made, goal-oriented physical therapy intervention can significantly enhance the functional abilities of patients with spinal cord injury (SCI) following the Post operative excision of an ependymoma. The exercises should be designed and implemented based on the principles of motor control, motor learning and neuroplasticity. Additionally, since patients with SCI often face emotional challenges, including educational and counselling sessions can be very beneficial.

Conflict of Interests

The authors have no conflict of interest to declare related to this article.

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