Somato Publications

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Case Report

Treatment of lower limb movement disorder in complete paraplegia caused by spinal cord injury with spinal neuromodulation: A case report

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Case Report

Spinal cord injury (SCI) may result in the impairment of motor, sensory, and voluntary functions below the spinal level of injury. The global prevalence of SCI is 1:1000, with an incidence of 4–9 new cases per 100 000 people per year. The most common causes of traumatic SCI are traffic accidents, falls, and acts of violence. Currently, the prevalence of quadriplegia is comparable to that of paraplegia [1]. To the best of our knowledge, this case report highlights the use of spinal cord stimulation for the first time to treat traumatic complete paraplegia of the lower extremities, with substantial efficacy. We present the case of a 38-year-old Asian male, a truck driver by profession. He had suffered a complete loss of motor and sensory functions in both lower extremities in a traffic accident 3 years ago. The accident also resulted in an AIS-B injury (the sensory function is preserved in the S4-S5 area of the sacral segment, but no motor function is preserved) at the T11/T12 level, accompanied by alternating numbness, deep sensory disturbances, and dyskinesia in both lower extremities, with no spasticity in the legs, and a motor score of 0 for all key leg muscles (No muscle contraction). The patient did not show any clinical improvement in both lower extremities after spinal internal fixation and could not stand or walk (walking index score for SCI: 0), despite extensive rehabilitation in a rehabilitation center. Therefore, with the consent of the patient and his family, we exploratively implanted a spinal cord stimulation (SCS) device in his body on April 26, 2020, to improve the symptoms of the lower extremities.

During the operation, an approximately 4-cm-long straight incision of was made on the L2-L3 dorsal surface under C-arm

Table 1: Changes in sensory and motor functions in both lower extremities of the patient

Study	Deep sensation			Alternating numbness	Muscle strength (grade)
Test	Position sensation	Movement sensation	Vibration sensation		
Before surgery	-	-	-	+	0
1 day after surgery	+	+	+	-	I
2 years after surgery	+++	+++	+++	-	III

-, +, and ++++ represent the degree of a symptom

Video Will play on page load

Video 1

guidance. The corresponding lamina was opened, and electrodes (model 565 DEFINE 2 × 8; Medtronic, USA) were inserted upward in the epidural space. Thereafter, the electrodes were connected to an implantable pulse generator (IPG), and the working parameters were set as follows: voltage, 1.8 V; pulse width, 210 μs; and frequency, 300 HZ through repeated tuning. The motor score of the patient's key muscles in both lower extremities was graded 1 after surgery. The muscles can contract slightly, but they cannot move the joints. The contraction of the muscles can be felt only when the muscles are touched. The patient's spinal cord injury grade was AIS-C. For position sensation assessment, we requested the patient to close his eyes and then placed his lower extremities in a certain position, and asked the patient to describe the position of the extremities. For movement sensation assessment, we requested the patient to close his eyes, and then flexed or bent his extremities, and asked the patient to describe the direction of movement. For vibration sensation assessment, we placed a vibrating tuning-fork on the bony prominence of the patient and asked the patient to describe the sensation of vibration and the duration of sensation. The patient underwent long-term, extensive rehabilitation training, including comprehensive limb training, gait and balance training, and whole-body muscle training. At the 2-year discharge follow-up, the patient was able to stand and walk with the assistance of a limb appliance (Video 1), and The patient's spinal cord injury grade was AIS-D. (Motor function is preserved below the nerve plane of spinal cord injury, and at least half of the key muscle strength below the nerve plane of spinal cord injury is restored to grade 3) (Table 1).

Discussion

Herein, we reported a case of using an SCS device to restore the functions of standing, walking, and trunk control in a patient with complete traumatic paraplegia of both lower extremities. Although the patient did not regain natural movement, this recovery is sufficient to demonstrate the considerable progress achieved with spinal neuromodulation in the treatment of SCI-induced paraplegia. Previously, it was considered that such a recovery is

mediated by remodeling of the residual descending pathway [2,3]. It has been hypothesized that a few nerve fibers can survive spinal injury, but these fibers remain functionally silent owing to low activities below the spinal level of injury [4]. This suggests that electrical stimulation of the spinal cord enhances the signal from the residual descending pathway, and this interpretation is further supported here by the better performance achieved with rehabilitation after SCS device implantation compared with that before SCS device implantation.

SCS is a neuromodulation technique used to relieve chronic pain, and it may serve as a new therapeutic option to relieve the symptoms of SCI in patients. Clinical trials with larger samples are needed to examine the applicability of this SCS approach in patients with different degrees of SCI.

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MB and PBZ participated in patient management; PBZ collected and analyzed patient data; MB provided technical support; PBZ wrote the manuscript; MB was responsible for critical revisions of the manuscript. PBZ wrote the manuscript.

Declarations of Interest

None.

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Informed Consent

Informed consent was obtained from the patients. We abide by the human subject's right to privacy.

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