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Case report on rehabilitation with exoskeleton wearable robots after spine surgery in elderly

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Introduction

In this case report, we report the impact of using exoskeleton wearable robots for over-ground gait training in postoperative rehabilitation of elderly patients following nerve root decompression surgery.

Case 1

An 88-year-old male patient who was diagnosed with a recent compression fracture at the L3 vertebral body without injury to the spinal cord and underwent posterior spinal fusion surgery at the L2-4 level. During the surgery, compression of both L3 roots was confirmed and decompression was performed. Six days after the surgery, the patient was transferred to the rehabilitation medicine department for intensive postoperative rehabilitation. On the tenth day after the surgery, the patient began over-ground robot-assisting gait training (RAGT).

Case 2

A female patient aged 69 years who was diagnosed with spinal stenosis at the L4/5 level and underwent a minimally invasive transforaminal lumbar interbody fusion procedure at the same level. During the surgery, compression of both L4 roots was confirmed and subsequently decompressed. The patient was transferred to the department of rehabilitation medicine for comprehensive postoperative rehabilitation on the fourth day following the surgery. On the sixth day following surgery, over-ground RAGT started.

Training Program

We employed the Angel Legs M20 (ANGELROBOTICS Co., Ltd., Seoul, Korea), an untethered wearable torque-assisting exoskeletal robot. A total of six sessions were conducted, each lasting 30 minutes. These sessions were performed a maximum of five times per week. The training began with weight-bearing and shifting exercises, including the time for putting on and taking off the exoskeleton, for the initial and last 5 minutes. The next 5 minutes were dedicated to sit-to-standing and stand-to-sitting training, and the remaining time was spent on gait training using a wheeled walker on a flat surface. In addition to the RAGT, conventional gait training (30 minutes per day) was also provided on the same day as before starting the over-ground RAGT.

Results

Each patient completed the over-ground RAGT. Table 1 presents the functional scales measured before and after the over-ground RAGT. During the training program, there were no serious adverse events.

Conclusion

The present study highlights the potential benefits of utilizing a torque-assisted exoskeletal wearable robot for over-ground gait training in the postoperative rehabilitation of elderly patients who have undergone nerve root decompression surgery. The treatment was shown to be safe and well-tolerated, including in the early postoperative phase.

Table 1. Changes of functional scales.

	Case 1	Case 2
MMT (MRC grade)		
Right hip/knee/ankle		
Pre-training	2/3/4	2/3/3
Post-training	3/4/4	4/4/4
Left hip/knee/ankle		
Pre-training	2/3/3	3/4/4
Post-training	3/4/3	4/4/4
MBI		
Pre-training	38	68
Post-training	51	95
FAC		
Pre-training	0	2
Post-training	2	3
BBS		
Pre-training	11	40
Post-training	15	48
10MWT (secs)		
Pre-training	uc	9*
Post-training	39*	5†
FTSST (secs)		
Pre-training	uc	25
Post-training	48	13

BBS; Berg balance test, FAC; functional ambulation category, FTSST; five times sit to stand test, MBI; modified barthel index, MMT; manual muscle test, MRC; medical research council, 10MWT; 10-meter walk test.

*using an anterior walker

†independently

Figure 1. Training using an untethered over-ground exoskeletal wearable robot with a physical therapist. Case 1: (A) Sit-to-standing training with a walker, (B) Gait training with a walker, Case 2: (C) Sit-to-standing training with a walker, and (D) Gait training with a walker.