

척수재활

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Gait with Rewalk™ and KAFO in patient with SCI

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Background

Lower extremities orthoses prevents second complications of longterm use of a wheelchair and enable individuals with spinal cord injury(SCI) to ambulate overground and maintain standing position. In our countries, bilateral knee-ankle-foot orthoses(KAFO) are used for gait reconstruction in patients with paraplegia. A more recent technology for ambulation in individuals with SCI is powered exoskeletal devices that enable gait in individuals with SCI. However, although several systematic reviews of powered exoskeletons have recently been published in worldwide, there are no known domestic research that have examined the clinical effectiveness and safety of powered exoskeletons in spinal cord-injured patients. In the current study, we selected ReWalk™, the most commercialized exoskeletal robots, and compared with KAFO to suggest the clinical data about their ambulation training and its efficacy.

Method

The 7 patients with American Spinal Injury Association Impairment Scale(AIS)-A paraplegia was trained to walk over ground with KAFO and ReWalk™ exoskeleton. 5 subjects received gait training with KAFO for 1st 4 weeks and continued the exercise with ReWalk™ after KAFO training, and 2 patients received gait training with devices in reverse order. Between training with two devices, they had wash out time for 2 weeks. The walking distance, velocity, cadence were evaluated to assess how quickly each participant could walk, and the physiologic cost index(PCI), oxygen consumption(VO₂, VO₂max), heart rate, maximal heart rate, metabolic equivalents(METs), energy efficiency(EE) were evaluated to assess energy expenditure. Evaluation were performed 2 times at each intervention when after 2weeks(10 sessions) and after 4weeks(the time intervention finished). The usability of the orthoses was evaluated with questionnaires when training with each devices was finished. The questionnaires consisted of safety, efficacy, efficiency, and satisfaction of the orthoses based on International Organization for Standardization/International Electrotechnical Commission(ISO/IEC).

Result

The distance, velocity, cadence of walking with the ReWalk™ were not significantly different with those of walking with KAFO. The VO₂, HRmax, METs, EE in walking with the ReWalk™ were significantly higher than those with KAFO. The score of questionnaires for usability of orthoses was higher in KAFO than Rewalk™.

Conclusion

The powered exoskeletal device(ReWalk™) enabled the patient with paraplegia to walk with lower energy consumption. If we complement the ability to walk and usability of the powered exoskeletal device, it could be envisioned to be a good orthoses for gait reconstruction which has significant advantage of energy saving.

Table 1. The comparison of energy consumption between KAFO and Rewalk™ at 30minutes walking test

	KAFO(POST)	Rewalk(POST)	p
PCI	7.78 ± 3.89	5.08 ± 1.07	0.128
VO ₂ (ml/min/kg)	12.85 ± 2.65	9.31 ± 1.89	0.028*
VO ₂ max(ml/min/kg)	37.80 ± 26.17	24.50 ± 8.36	0.063
HR	140.56 ± 13.81	118.86 ± 15.19	0.028*
HR max	156.00 ± 18.51	131.57 ± 20.47	0.018*
METs	3.76 ± 0.58	2.66 ± 0.54	0.018*
EE(Kcal/min)	3.98 ± 0.96	2.98 ± 0.76	0.028*

(평균±표준편차), *p<0.05

Table 2. The comparison of usability between KAFO and Rewalk™ by 5-point Likert scale questionnaires.

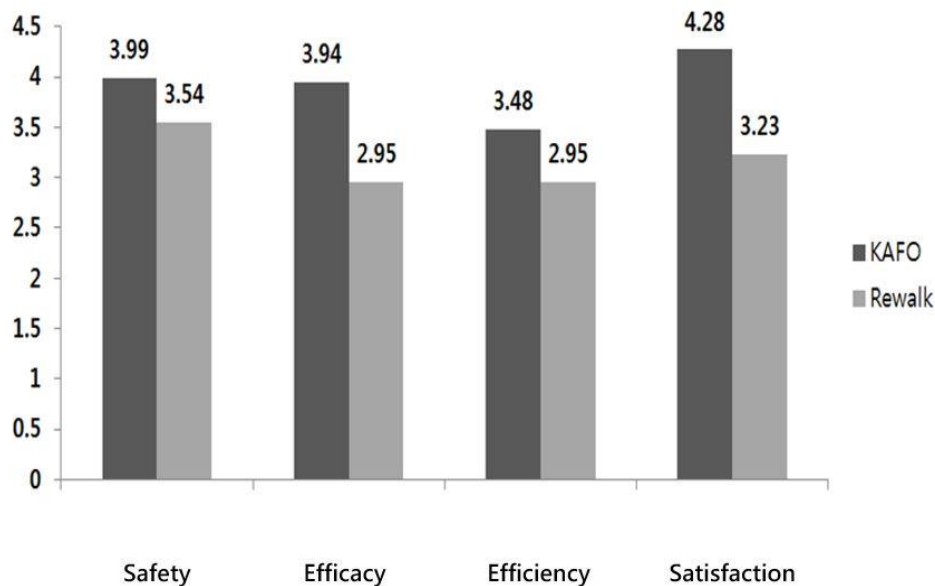




Fig 1. The patient walking over ground with KAFO and ReWalk™ for gait training