Effects of robot training on bowel function in patients with spinal cord injury

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Abstract. [Purpose] The purpose of this study was to compare the effects of body weight-supported treadmill training (BWSTT) and robot-assisted rehabilitation (RAT) on bowel function in patients with spinal cord injury with respect to defecation time and defecation drug dose (enema). [Subjects] Twenty-four patients with spinal cord injury participated in the study. All subjects had an incomplete injury ranging from level T8 to L2. [Methods] The subjects were randomly divided into BWSTT and RAT groups. Walking training was provided to both groups for 20 minutes, four times a week, for one month. The defecation time and enema dose were measured before and after the experiment. [Results] The RAT group showed significant shortening of defecation time and decrease of enema dose. [Conclusion] The results demonstrated that significantly better improvement in bowel function can be achieved with RAT.

Key words: Robot-assisted rehabilitation, Bowel function, Spinal cord injury

INTRODUCTION

Bowel dysfunction is one of the most common problems among patients with spinal cord injury. During the early stage of the injury, the internal layer of the rectum and the anal sphincter muscle are in a stage of complete incontinence. The voiding reflex is restored through recovery of the central lumbosacral spinal cord after the acute stage1). Peristalsis of the intestine and right side of the colon is maintained by innervation from the vagus nerve so that feces are transported to the large intestine2). After a spinal cord injury, patients suffer from several types of problems such as decreased muscle power and sensation as well as impairment of the respiratory system and other functions3). Specifically, spinal cord injury causes paralysis and high spasticity of the anal sphincter, or results in voiding dysfunction4). Most patients with spinal cord injuries choose drug therapy to treat their bowel dysfunctions. A study published in 2013 adopted manipulation therapy to improve bowel function5). In general, increasing attention has been paid to the treatment of bowel function, although relevant studies in this field remain rare.

According to studies on walking function, rhythmic and circulate ambulation training of the lower limbs can stimulate intestine peristalsis and bowel function, and several methods of walking training, such as body weight-supported treadmill training (BWSTT) and robot-assisted rehabilitation (RAT) can be adopted to help patients with spinal cord injury. Currently, RAT is widely used during the recovery process. The biggest difference between the body weight-supported treadmill robot training and the existing supported ambulation training is the addition of a mechanical assistant in the former so that alternative steps with both feet can be achieved by the patients. Besides, simulation of the normal walking pattern facilitates input from the peripheral nerve endings; in this manner, the remaining central nervous system can be stimulated so that the nerve regeneration of the nerves of traumatic spinal cord injury can be completed. Recently, some studies have shown that this method has a significant effect on the improvement of response time6).

Therefore, this study aimed to compare the effects of BWSTT and RAT on bowel function in spinal cord injury patients with respect to defecation time and defecation drug dose (enema).

SUBJECTS AND METHODS

Twenty-four patients with spinal cord injury participated in the study. All subjects had an incomplete injury ranging from level T8 to L2, and the incidence was within six months. Subject characteristics are detailed in Table 1. The purpose and procedure of this study were explained to the subjects, and all subjects gave their informed consent for participation.
in the study. The study was approved by the Research Ethics Committee of China Rehabilitation Research Center, and the IRD number for this study is 2014-8.

The subjects were randomly divided into BWSTT and RAT groups. The BWSTT group consisted of 12 subjects (7 males, 5 females), and the RAT group consisted of 12 subjects (9 males, 3 females). Both groups had undergone defecation management training to ensure adequate daily intake of water and dietary fiber. Additionally, manual therapy was also adopted to stimulate the patients’ intestines.

The BWSTT group, in addition to standard rehabilitation training, underwent BWSTT. In the RAT group, the same rehabilitation training was carried out with the treadmill training team, and walking training was carried out with a rehabilitation training robot (MBZ-CPM1, ManBuZhe [Tian Jin] Rehabilitation Equipment Co., Ltd. China).

In the BWSTT and RAT groups, the initial training speed was 1.5 km/h, which was progressively raised to 1.8 km/h as quickly as possible while maintaining gait quality. The body weight system was initiated at 35%, and 70% guidance force was provided for the participants.

Both groups underwent walking training for 20 minutes, four times a week, for one month. The experimental measures were the defecation time and enema dose in both groups before and after the experiment.

Two-way repeated measures ANOVA was used to test statistically significant differences and the factors were intervention and group. If a significant interaction was found, the paired t-test was used for a before and after intervention comparison. Data were analyzed using SPSS Ver. 17.0 for Windows. The level of statistical significance was set at 0.05.

RESULTS

There were no significant differences between the BWSTT and RAT groups in terms of subject characteristics and all measures before the intervention (Table 1).

Two-way ANOVA revealed significant interactions among the defecation time and enema dose of the two groups, indicating that the changes between the groups were different. However, there was no significant difference in the results of the BWSTT group. The RAT group showed significant shortening of the defecation time and decrease of enema dose (Table 2).

DISCUSSION

It can be concluded from this research that compared with the BWSTT group, the RAT group’s defecation periods were shorter, and the enema dose was decreased.

The reason for this result is that compared with standard walking training and BWSTT, the robotic walking training enabled the bilateral lower limbs to perform an alternative and circulatory movement, which can effectively adjust abdominal pressure and improve intestinal peristalsis; in this manner, the bowel function can also be improved.

In future studies, changes in the thickness of the transversus abdominis muscle during the training need to be evaluated, and changes in the intestinal peristalsis frequency should be measured.

ACKNOWLEDGEMENT

This paper was supported by the Research on Design Theory and Compliant Control for Underactuated Lower-Extremity Rehabilitation Robotic Systems, Code: (51175368); 2012.01–2015.12.

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