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Research Article

Effect of Robotic Assisted Gait Training on functional and psychological improvement in patients with Incomplete Spinal Cord Injury

Abstract

Background: Several studies provide evidence that Robotic-assisted gait training (RAGT) promotes motor recovery and functional improvement in patients with spinal cord injuries.

Context and purpose of the study: The present study was conducted to assess the effect of RAGT on functional and psychological improvement in patients with incomplete spinal cord injury as compared to conventional methods. Forty patients with incomplete spinal cord injury were recruited to this study. They all received conventional rehabilitation program. Twenty patients received RAGT in addition. Baseline measurements of outcome variables were taken before and at week 12 after treatment. Posture control and balance were assessed by Berg Balance Scale [BBS].Functional ambulation was assessed by Functional ambulation category scale [FAC]. Depression was assessed by the Beck depression inventory [BDI]. World Health Organization Quality of Life Questionnaire-BREF (WHOQOL-BREF) was used.

Results: The BBS was significantly improved in both groups, while FAC improved significantly in RAGT group and non-significantly in conventional group. WHOQOL-BREF improved significantly in RAGT group only. The results of BDI and HOQOL-BREF showed a significant difference between both groups in week 12.

Conclusion: RAGT can lead to better improvement in ambulatory function as well as psychological condition and quality of life compared to conventional treatment in incomplete SCI patients.

Introduction

Improvement of walking ability is the main target of rehabilitation programs of patients after spinal cord injury (SCI), a factor associated with quality of life and psychological wellbeing [1]. The main limitations of over-ground walking ability for patients with SCI are reduced sensory motor coordination, spasticity, decreased muscle strength and impaired balance [2]. Different treatments have been attempted to facilitate walking ability, such as manually assisted over-ground training and manually assisted treadmill training. However, the techniques are cumbersome and highly demanding in terms of staffing and time [3]. Robotic-assisted gait training (RAGT) was introduced in the late1990s. Different systems are commercially available, including the "Lokomat" [4-7]. The Lokomat is a motor-driven gait orthotic secured to a patient's legs while the patient him/herself is supported by a body weight support (BWS) system over a motorized treadmill [8]. The patient's legs are guided on the treadmill according to a pre-programmed physiological gait pattern [4]. It has the advantage of repeatedly conducting a pre-programmed gait pattern. Previous studies provide evidence that RAGT promotes motor recovery and functional improvement [9,10]. However, other study showed that there was no significant difference between RAGT and conventional therapy [3]. The present study was conducted to assess the effect of RAGT on functional and psychological improvement in patient with incomplete spinal cord injury as compared to conventional method.

Materials and Methods

Forty patients were recruited to this study from those admitted to Agouza rheumatology & rehabilitation military centre, Giza, Egypt with incomplete spinal cord injury. Patients

were both military and civilian. Inclusion criteria were onset less than 6 month and age 20 to 60 years old. Exclusion criteria were patients with pressure ulcers, contractures of the hips and knee joints, severe cognitive impairment and patients having lower motor neuron lesion. No previous local anti-spastic measures had been used for any of the recruited patients. Twenty patients were assigned to the RAGT group [gr A]: Received RAGT in addition to the rehabilitation program (mean age 32.4±11.8 years and mean injury duration 4.7±4.6months), and 20 patients to the conventional group [gr B]: received rehabilitation program only (mean age 32.7±10.5 years and mean injury duration 3.7±3.1 months). The RAGT group received RAGT with regular physiotherapy in the following schedule: 3 days with RAGT and 2 days with regular treatment a week. The lokomat system of Hocoma, Switzerland was used .Each session lasted for 60 minutes. The body weight support was adjusted to the minimum without knee buckling or toe dragging. The walking speed was gradually increased up to 1.5 km/hr. Sessions of the conventional therapy group were performed 30 minutes each, 5 sessions a week, included functional exercises according to the muscle grading, slow prolonged stretching of the spastic muscles, and strengthening exercises to the anti-spastic muscles. The conventional therapy included active or assisted active exercises. Baseline measurements of outcome variables were taken before they underwent intervention (W0) and at week 12 after treatment (W12). Patient's impairment was identified according to Asia impairment scale [ASIA] [11]. Posture control and balance were assessed by Berg Balance Scale [BBS] [12]. Functional ambulation was assessed by Functional ambulation category scale [FAC] which has six categories (0–5) that distinguish level of physical support irrespective of technical aids used [13].

Depression was assessed by the Beck depression inventory [BDI], a 21-questionmultiple-choice self-report inventory, which is one of the most commonly used instruments to measure the presence and severity of depression [14]. The cutoff-scores according Kendal let al., are 0-9 indicating normal, 10-19 indicating mild depression, 20-30 indicating moderate depression, and 31-63 indicating severe depression [15] .

World Health Organization Quality of Life Questionnaire-BREF (WHOQOL-BREF) was used to assess the four domains defining the QOL: physical, psychological, social, and environmental. The higher the QOL score the higher the life satisfaction [16].

Statistical analysis

The data were analyzed using the statistical program SPSS version 15. Results were expressed as mean ± standard deviation (SD). The Kruskal Wallis test with exact method was used for comparing the RAGT group and the conventional group concerning the BBS, FAC, BDI and WHOQOL-BREF in W0 and in W12. The Friedman test, which is a non-parametric alternative to the one-way ANOVA, was used with exact method for the repeated measures of the BBS, FAC, BDI and WHOQOL-BREF in the follow up visits within the same group. The level of statistical significance was <0.05 (2-tailed).

Results

All patients in RAGT group and in the conventional group were ASIA B and C. Six patients had tetraplegia (3 in each group) while 34 patients had paraplegia (17 in each group). At the beginning of the study (W0), in RAGT group; 17 patients were not be able to walk, 3 patients could walk by walker, and one patient could walk by using long leg brace (LLB). While at the end of the study (W12), 3 patients still can't walk, 3 could walk by walker, 3 could walk by LLB, and 11 patients were able to walk. Although the conventional group had the same features in W0; 17 patients were not be able to walk, 3 patients could walk by walker, and one patient could walk by using long leg brace (LLB). The outcome was slightly worse compared to the RAGT group; 5 patients still can't walk, 3 patients could walk by walker, and 2 patients could walk by LLB, and 10 patients were able to walk.

The BBS was significantly improved in both groups in W12, while FAC improved significantly in RAGT group in W12 and non-significantly in conventional group. The comparison between W0 and W12 concerning FAC and BBS in both groups is shown in table 1.

The BDI and WHOQOL-BREF were significantly improved in RAGT group, while showed less improvement in conventional group in W12. The comparison between W0 and W12 concerning BDI and WHOQOL-BREF in both groups is shown in table 2.

No significant difference was detected between the results of BBS and FAC either in W0 nor W12 in both groups (Table 3). While the results of BDI and WHOQOL-BREF showed a significant difference in W12 in both groups (Table 4).

Discussion

In the present study, both patient groups showed improvement in the functional ambulation category scale by the end of the study but the change was statistically significant only in the RAGT group. These results are in agreement with previous studies by Alcobendas-Maestro et al., 2012 and Shin et al., 2014 which found that RAGT groups improved significantly from baseline to follow-up compared to conventional therapy

Table 1: BBS and FAC scale in RAGT & conventional group in W0 & W12.

		RAGT group N=20	Sig.	conventional group N=20	Sig.
BBS	W0	7.7±5.2	0.001*	9.1±6	0.001
	W12	22±15.2		22±14	
FAC	W0	0.4±0.5	0.02*	0.4±0.5	0.114
	W12	2.5±2.1		2.1±1.9	

Table 2: BDI& WHOQOL-BREF in RAGT & conventional group in W0 & W12.

		RAGTgroup N=20	Sig.	conventional group N=20	Sig
BDI	W0	25.1±11.6	0.001*	28.4±10.9	0.05*
	W12	11.2±13.3		21.9±12.9	
WHOQOL-BREF	W0	61.2±13.2	0.001*	56.7±10.1	0.06
	W12	84.9±18.3		60.1±8.8	

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Table 3: The comparison between RAGT group and conventional group concerning BBS and FAC in W0 and W12.

		Chi-Square	Exact Sig.
BBS	W0	1.369	0.242
	W12	0.018	0.892
FAC	W0	0.001	1.000
	W12	0.165	0.961

Table 4: The comparison between RAGT group and conventionsl group canserning BDI and WHOQOL-BREF in W0 and W12.

		Chi-Square	Exact Sig.
BDI	W0	1.451	0.228
	W12	13.269	0.001*
WHOQOL-BREF	W0	3.460	0.07
	W12	15.422	0.001*

groups [9,17]. This is in contrast to the study of Labruyère and van Hede, 2014 who found that there were no significant differences in changes in scores between the 2 interventions, except for maximal walking speed (10MWT), which improved significantly more after strength training than after RAGT but sample size was small (9 patients) [18]. The BBS significantly improved in both patient groups by the end of the study .This is in agreement with the study by Labruyère and van Hede, 2014 [18], where there were no statistical differences between the changes in scores due to RAGT and strength training for balance measures.

Depressive disorders are the most common psychological problems in spinal cord injury (SCI) patients [19]. In our study both patient groups completed the BDI and WHOQOL–BREF questionnaires for assessment of depression and quality of life at entry and after completion of the program. All patients studied had some degree of depression at entry. A study by JiCheol Shin et al., 2012 found that the patients within six months after SCI injury had higher rate of depression [17]. Previous studies have shown that participating in gait training without support has a significant potential to improve self–image and positive change of emotion [20, 21]. In our study there was a statistically significant improvement in the BDI score in the RAGT group and improved less significantly in the other group. The WHOQOL–BREF was significantly improved only in RAGT group.A previous case report has shown significant improvement in function, psychological and cognitive status after intensive Lokomat training in a chronic stroke patient which was related to the task oriented exercises and computerized visual feedback which increases patient output and motivation [22]. By comparing the results of both groups in the recent study, a significant difference was recorded between the improvement of BDI and WHOQOL–BREF in both groups. Our results show that RAGT was better than conventional therapy in improving ambulatory function, depression scores as well as quality of life questionnaire.

The limitations of the present study were the relatively small number of patients in both groups (twenty each) and the relatively short follow up period which was twelve weeks.

Conclusion

RAGT lead to better improvement in ambulatory function as well as psychological condition and quality of life compared to conventional treatment in studied patients. Future studies are required on larger scale and for longer follow up periods.

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