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Improvement of locomotor function in individuals with chronic spinal cord injury with antigravity treadmill: A case report

Poonam Bajaj, Aashish Contractor, Shivangi Salian, Shreya Gala

ABSTRACT

Introduction: Access to safe and effective weight bearing exercise for spinal cord injury patients is a challenge. The objective of this case report is to highlight the potential use of an antigravity treadmill for improvement in locomotor function (gait speed and endurance) in two individuals with lower thoracic level, chronic, incomplete spinal cord injury (iSCI).

Case Series: Two young male patients, with lower thoracic level chronic iSCI underwent gait training in an anti-gravity treadmill. The 6 Minute Walk Test (6MWT) and 10 Meter Walk Test (10MWT) were used as outcome measures of the pre- and post-anti-gravity treadmill training period. Both participants showed improvement in the minimal clinically important difference in the 10MWT and the 6MWT. However only one of them met the minimal detectable change criteria for chronic iSCI. Our results are indicative but not conclusive of improvement in gait speed and endurance in chronic iSCI.

Conclusion: This case series demonstrates the potential use of the anti-gravity treadmill in improvement of locomotor performance in terms of gait speed and endurance in addition to providing a fall safe exercise environment for exercise benefitting individuals with iSCI.

Keywords: Anti-gravity treadmill, Exercise, Fall-prevention fall safe, Spinal cord injury

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INTRODUCTION

Ambulation outcomes are of primary concern after a spinal cord injury. They are dependent on the level of lesion, whether the lesion is complete or incomplete, gender, endurance, and the amount of physical activity undertaken after the injury [1]. A systematic review shows a high level of evidence that repetitive and intensive gait training benefit individuals with chronic incomplete spinal cord injuries (iSCI) [2, 3].

It is of no doubt that exercise is beneficial for musculoskeletal, neurological, cardiovascular, pulmonary, and other systems of the body. Access to safe and effective weight bearing exercise is a challenge for the individual with spinal cord injury.

Several gait training strategies have been systematically reviewed for the rehabilitation of individuals with spinal cord injuries [4]. On a literature review it was found that the number of studies examining the use of an anti-gravity treadmill for gait training in the population with spinal cord injuries was extremely sparse. Hence it was undertaken to explore the possibility of using an anti-gravity treadmill for the improvement of locomotor performance (gait speed and endurance) in individuals with iSCI.

CASE SERIES

Two young male participants with chronic iSCI at the thoracic level were included in this case series. They were trained on an anti-gravity treadmill for 24 sessions over a period of 12 weeks. They were assessed pre and post for any clinically significant changes.

Case 1

Participant A was a 24-year-old male, 20 months' post-injury due to a tree falling on his spine resulting in vertebral fractures. He was classified as AIS (American Spinal Injury Association scale) C, at thoracic level, D7–D11, functionally a limited community ambulatory with a single point cane [5]. He needed a wheelchair for outdoor ambulation primarily due to spasticity and imbalance. He had undergone an intensive rehabilitation protocol including all standard therapeutic techniques and measures at our neurological rehabilitation unit. His Walking Index for Spinal Cord Injury–II (WISCI-II) level before starting anti-gravity treadmill training was 19 [5].

Case 2

Participant B was a 28-year-old male; three years post-injury due to a road traffic accident. He was classified as AIS B at thoracic level D10. Functionally a limited household ambulatory with a walker and unilateral knee ankle foot orthosis (KAFO) and an Ankle Foot Orthosis (AFO) on the contralateral side. He needed a wheelchair outdoor. He had been through a rehabilitation program at an external clinic previously. His WISCI-II level before starting anti-gravity treadmill training was 9 [5].

Both patients were given treadmill training in an Alter-G TM anti-gravity treadmill for 24 sessions over a period of 12 weeks. Two sessions per week of a duration of 40 minutes each, which included intermittent rest periods totaling 10 minutes, were done. The anti-gravity treadmill allows unloading the individual up to 20% of body weight and loading increments or decrements can be calibrated up to 1% at a time. It allows speed increments within a calibration of 0.1 km per hour (kmph). The participant has to do a special pair of shorts that can be zipped into the anti-gravity chamber. Air pressure is used to offload the individual. Both participants wore their usual orthotics during the anti-gravity treadmill training. They did not need their assistive devices—since they were ensconced within the chamber of the anti-gravity treadmill which is a fall-safe environment.

Both participants were started on the treadmill at their over-ground gait speed at 20% unloading with their assistive orthotics. Loading was gradually increased to 80% of body weight over the first six sessions. Once the participant was comfortable at this loading, speed was gradually increased to tolerance. They were monitored on the Borgs Rating of Perceived exertion and the level did not exceed somewhat hard to hard [6]. They were also monitored for heart rate and oxygen saturation. At no point during the training was the heart rate allowed to exceed target heart rate.

Outcome measures: There are several valid, reliable, and responsive outcome measures for monitoring locomotor performance in acute iSCI. However, no specific outcome measures exist for chronic iSCI. The WISCI-II and the 10 Meter Walk Test (10MWT) have been found to be the most commonly used clinical tests to measure gait changes in individuals with iSCI [3]. The 6 Minute Walk Test (6MWT) has been found to be a measure of endurance in the population with iSCI. Hence the 10MWT and the 6 MWT were used as outcome measures in this case series.

Informed consent

Informed consent has been obtained from both participants of this study and approval from the Institutional Ethical Committee has been obtained.

Pre- and post-values of the two selected outcome measures (6MWT and 10MWT) were taken for assessing the participants after 24 sessions of anti-gravity treadmill training over 12 weeks.

For the 10MWT the participants were instructed to walk at their preferred speed with their routine assistive devices and the gait speed was calculated by using the time taken to cover the standard distance of 10 meters. Acceleration and deceleration were accounted for as per test instructions (a 14-meter walkway was used). At the time of commencement of training with the anti-gravity treadmill both participants were not receiving any therapy. Participant A had a gait speed of 0.5 meters/second and participant B had a gait speed of 0.19 meters/second, prior to anti-gravity treadmill training.

Participant A's gait speed improved to 0.66 meters/second and participant B's gait speed improved to 0.27 meters/second on the 10MWT at the end of 12 weeks.

The minimal clinically important difference (MCID), on the 10 MWT in individuals with spinal cord injuries is 0.06 m/s. Both participants showed improvement more than the MCID value. The Minimal Detectable Change (MDC) for chronic iSCI is 0.13 m/s. Participant A showed a minimal detectable change after anti-gravity treadmill training, whereas participant B's improvement did not meet the benchmark (Table 1) [7]. The amount of assistance required for both participants did not change as a result of anti-gravity treadmill training—the WISCI-II level remained the same.

Prior to anti-gravity treadmill training the 6MWT distance of participant A was 167.4 meters and that of participant B was 42.7 meters. After 24 sessions of anti-gravity treadmill training the 6 MWT distance of participant A improved to 236.8 meters and that of participant B improved to 99.5 meters. Both participants showed an improvement in minimal clinically important difference (MCID) values for individuals with chronic spinal cord injuries. The MCID value for individuals with iSCI is a change of 0.1 meters/second gait speed over the distance covered by the 6MWT (Table 1).

Table 1: 10 Meter Walk and 6 Minute Walk Test values

	Pre-training values		Post-training values	
Participant	**10 Meter Walk Test Pre-training (m/s)**	**6 Minute Walk Test pre-training (meters)**	**10 Meter Walk Test post-training (m/s)**	**6 Minute Walk Test post-training (meters)**
A	0.5	167.4	0.66	236.8
B	0.19	42.7	0.27	99.5

DISCUSSION

Our results are indicative of improvement in gait speed and endurance for both participants with chronic iSCI. However, gait speed did not improve enough to meet the MDC criteria for participant B, who was graded as an AIS B (indicative of more severity of injury). Both participants showed improvement in endurance.

CONCLUSION

The anti-gravity treadmill is relatively unexplored as a treatment tool for spinal cord injuries. Exercise options for individuals living with iSCI are limited and an anti-gravity treadmill can potentially provide a fall-safe environment for exercise for individuals with iSCI (at dorsal and lumbar levels). Both participants reported an improvement in their overall satisfaction and well-being, though this was not objectively measured. As this is a case series valid results cannot be obtained. However, the results are certainly encouraging enough for a larger study. Thus the anti-gravity treadmill could be looked upon as an equipment that could potentially provide an avenue for physical activity in weight bearing for decreasing osteoporosis in the long term and also improving and maintaining cardiovascular and pulmonary health in the population with iSCI.

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Author Contributions

Poonam Bajaj – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Aashish Contractor – Analysis of data, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Shivangi Salian – Acquisition of data, Drafting the work, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Shreya Gala – Acquisition of data, Drafting the work, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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Consent Statement

Written informed consent was obtained from the patient for publication of this article.

Conflict of Interest

Authors declare no conflict of interest.

Data Availability

All relevant data are within the paper and its Supporting Information files.

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ABOUT THE AUTHORS

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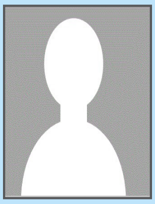

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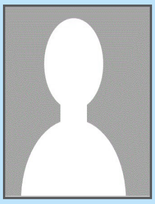

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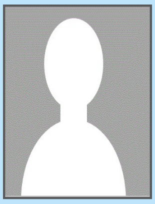

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