Journal of Rehabilitation Therapy

Case Report Open Access

Dynamic Overground Body Weight-Supported Gait Rehabilitation in a Mechanically Ventilated Patient

Megan Haught[1], Jennifer K. Bodine[1], Ahmed Y. Khan[2], Joseph Hayter[1], Kristin Seaburg[3], Amy E. Teale[4,5]

[1]Cardiopulmonary and Orthopedic Department, Sunnyview Rehabilitation Hospital, Schenectady, NY.
[2]Schenectady Pulmonary Critical Care, Schenectady, NY.
[3]Patient Therapies Department, Sunnyview Rehabilitation Hospital, Schenectady, NY.
[4]James A. Eddy Research Institute, Sunnyview Rehabilitation Hospital, Schenectady, NY.
[5]Address correspondence to Amy Teale, James A. Eddy Research Institute, Sunnyview Rehabilitation Hospital, Schenectady, NY

Article Info

Article Notes
Received: August 26, 2025
Accepted: September 22, 2025

***Correspondence:**
*Dr. Amy E. Teale. James A. Eddy Research Institute, Sunnyview Rehabilitation Hospital, Schenectady;
Email: Amy.Teale@sphp.com.

Key Words:
Dynamic Body Weight Support
Mechanical Ventilation; Respiratory Failure
Inpatient Rehabilitation
Rehabilitation Research
Gait/Balance Training

Abstract

Objective: Sufficient patient mobilization can be difficult to achieve with mechanical ventilation during a patient's hospital stay. This case report describes the novel use of overground dynamic body weight-supported (DBWS) gait and balance training in a mechanically ventilated patient. Feasibility and safety of the device are demonstrated for this case, and the patient's recovery trajectory and outcomes are described.

Methods (Case Description): A 68-year-old female admitted to inpatient rehabilitation following a prolonged hospital stay received dynamic body weight-supported gait and balance training while mechanically ventilated. DBWS gait and balance training session parameters were tracked and functional outcomes assessed at regular intervals.

Results: DBWS gait training was well-tolerated; the patient demonstrated immediate carryover to overground ambulation and improved endurance following several sessions. Patient progression warranted changes to the type and duration of DBWS training activities across sessions, all of which were well-accommodated by the DBWS system.

Conclusion: Dynamic body weight support-based training was a safe, effective means of engaging this mechanically ventilated patient in overground gait training during her inpatient rehabilitation stay. Specific guidelines and precautions can ensure that each patient is a good match for this modality before initiating therapy sessions. In addition, patients should be continuously reassessed, and adjustments made as therapy progresses.

Impact: To our knowledge, this case report is the first to describe the use of overground DBWS gait training in a mechanically ventilated patient, with demonstrated feasibility, safety, and functional outcome improvement. It also provides clinical guidance for patient selection and overground gait training therapy sessions.

Background and Purpose

Mobilization of patients during acute hospitalization and inpatient rehabilitation is crucial to restoring strength, preventing physiological deconditioning, and improving functional outcomes[1,2]. Often, patients do not receive optimal doses or intensities of upright mobilization due to several factors, including difficulty in mobilizing patients or concern for patient falls[3]. Many patients who would benefit from early mobilization are difficult to mobilize due to medical complexity or weight, requiring the assistance of several staff members and precautions to ensure patient safety[4]. Limited mobilization during therapy sessions may result in the inability to practice real-world scenarios that pose a fall risk and can lead to decreased functional gains during inpatient rehabilitation.

For patients recovering from critical illness, early active mobilization protocols may be initiated safely in the ICU and continued in the post-ICU setting[5-8]. In patients receiving mechanical ventilation for more than 24 hours, active mobilization is associated with improved strength, functional independence, and the ability to wean from ventilation[9,10]. In addition, early active mobilization may decrease overall length of stay in the intensive care unit and hospital[2]. With shortened lengths of stays, early mobilization has emerged as a critical component of patient therapy in inpatient rehabilitation.

Dynamic body weight supported (DBWS) gait and balance training is a promising intervention to promote early mobilization of patients that are difficult to mobilize[11]. This therapeutic approach involves partially supporting the body's weight while allowing the patient to practice gait and balance training in a controlled environment. DBWS gait training systems are designed to allow overground gait training while maintaining a consistent level of body weight support regardless of patient motion, encouraging natural movements and allowing patients the freedom to learn and test balance reactions safely without the risk of falling[12]. By reducing the load on the lower extremities and minimizing the risk of falls, DBWS gait training facilitates repetitive, task-specific practice, which is critical for motor learning and functional recovery. Activities can be varied and may include stepping over objects, sit-to-stand exercises, and stair ascent and descent, among others.

The effectiveness of DBWS gait training has been demonstrated across various patient populations undergoing rehabilitation; most frequently, they are used in patients recovering from neurological injuries including stroke, traumatic brain injury, and spinal cord injury[13-17]. For individuals with stroke, DBWS systems have yielded greater functional gains versus standard of care gait training during inpatient rehabilitation, potentially due to greater intensity and task repetition with DBWS[13,14]. For individuals with spinal cord injury, overground DBWS can be an effective method of gait training yet shows little benefit over other forms of assisted gait training[16,17].

The Vector Gait and Safety System is one type of DBWS system that utilizes a ceiling mounted robotic track to provide dynamic body weight support and trolley tracking. This design allows the patient to safely practice and transition between sit to stand exercises, dynamic balance activities, and gait training by unloading a percentage of the patient's body weight. The dynamic nature of the weight support system, which adjusts in real-time to the patient's gait patterns, may promote adaptive responses and enhance motor control. The Vector system analyzes patient movement and prevents falls, allowing the patient to challenge themselves beyond what is possible in conventional care while maximizing patient and therapist safety[11]. This increased patient confidence can empower the therapist to develop more effective and challenging treatment regimens, thus accelerating the rehabilitation course for many patients.

While the efficacy of DBWS, and the Vector system specifically, has been demonstrated in neurological populations, the safety features make it appealing for earlier mobilization of additional patient populations, including individuals recovering from medically complex cardiac or pulmonary conditions. Individuals that are particularly susceptible to deconditioning and loss of motor function while being difficult to mobilize are those recovering from critical illness who were previously (or currently) mechanically ventilated[9,10]. In this case study, we report the feasibility and effectiveness of the Vector Gait and Safety System for gait training of a mechanically ventilated patient recovering from complex medical conditions involving multiple stays in the intensive care unit. To our knowledge, this is the first report of the use of DBWS with a mechanically ventilated patient in the literature. Through an examination of the patient's progress and treatment outcomes, we aim to provide an initial description of the practical implementation of DBWS gait training for such patients and its potential benefits in rehabilitative care.

Case Description

A 68-year-old female with a complicated medical history including coronary artery disease, diabetes mellitus, morbid obesity, hypothyroidism, hypertension, hyperlipidemia, recurrent pneumonia, and congestive heart failure was admitted to an acute care hospital for sepsis following pneumonia. Following a 7-day stay, she was transferred to a skilled nursing facility to continue recovery (Figure 1). After 2 weeks, she was readmitted to the acute care hospital due to altered mental status, hallucinations, and hypoxia. The patient became obtunded, requiring intubation with mechanical ventilation for bacterial pneumonia, severe hypercapnia, and sepsis with acute kidney injury. CT of the head showed no acute intracranial findings. The patient was continuously intubated with mechanical ventilation for two weeks and extubated to non-invasive ventilation for 2 days before developing acute hypercapnic respiratory failure, requiring re-intubation with mechanical ventilation. Tracheostomy and gastrostomy tubes were placed.

The patient was transferred to an inpatient rehabilitation facility (IRF) following a 34-day acute hospitalization. Upon admission, the patient presented as dependent for mobility requiring a mechanical sit-to-stand lift for transfers, was

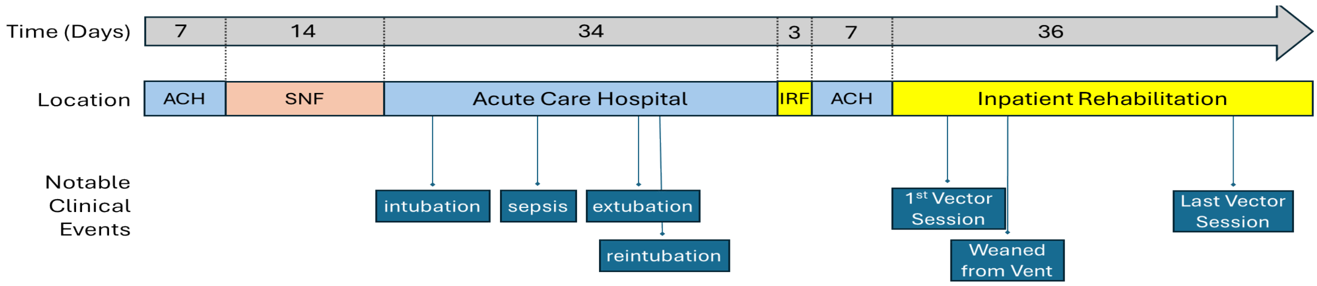

Figure 1. Timeline of case progression.
ACH – acute care hospital; IRF – inpatient rehabilitation facility; SNF – skilled nursing facility
Time in days, patient location, and notable clinical events are shown, highlighting the patient's lengthy (greater than 3 months) overall hospitalization and complicated course of recovery.

non-ambulatory, and was on a mechanical ventilator. The patient was only seen for her initial evaluation at the IRF before developing a mucus plug with subsequent decline in respiratory status requiring transfer back to the acute care hospital. The patient was treated with mucolytics as well as systemic steroids over a weeklong course before being cleared for transfer back to the IRF.

Upon readmission to the IRF, the patient's mobility status had declined further. She was unable to sit unsupported at the edge of the bed, required a dependent mechanical sling lift for transfers, and was non-ambulatory. The patient remained on the ventilator via tracheostomy, exhibited bilateral upper and lower extremity weakness, and displayed compromised cardiopulmonary endurance. During the first week of her IRF stay, the patient demonstrated sufficient trunk control and standing tolerance in a mechanical standing lift (Sara lift, 3x5-7 minutes) for traditional therapy. Because of this, she was identified as a candidate for the DBWS system (Vector Gait and Safety System) with the goal of improved functional mobility, early ambulation, and decreased time to wean from the ventilator.

A protocol was written to determine patient eligibility, ensuring the patient was tolerating traditional therapy, did not have any contraindications, was medically stable, and had no medical events within the last 48 hours. Physician clearance was received. A mock code for emergent removal of a ventilated patient from the Vector was performed and included nursing, physical therapy, respiratory therapy, nurse management staff, and the attending physician. Because this was a novel use of the DBWS system, only staff directly trained by the DBWS system vendor led the sessions.

Vector sessions initially began with a 25% offloading setting for the patient, but the progression of offloading was dynamically adjusted based on several clinical factors, including the patient's tolerance, respiratory status, ventilator weaning progress, fatigue level, and the specific task being performed. Minimal offloading of approximately 10 pounds was used during overground walking, while stair training required up to 50 pounds. Throughout all sessions, fall prevention was supported by the system's active body control feature set to maximum, and a 4-inch distance threshold once the patient achieved standing. This robotic component intelligently detects and responds to potential falls by analyzing the patient's velocity and downward force. During early sessions, the ascent assist feature was also used for transfer training. This function monitors the patient's standing speed and automatically increases unloading if the patient is not rising quickly enough, then returns to the original unloading level once standing is achieved. Safety monitoring measures were in place, including continuous telemetry monitoring and vitals taken at the beginning, middle, and end of each session. Respiratory therapy was always on unit and available during Vector sessions.

During her IRF stay, the patient was able to complete nine sessions within the DBWS system in conjunction with traditional therapy interventions, which included functional mobility training, gait training including stairs, neuromuscular re-education, secretion management and pulmonary hygiene, and therapeutic exercise for strength and cardiovascular endurance (Table 1). During the first two DBWS sessions, the patient was on the ventilator, tolerating less than 30 minutes of training time, and offloading 18-19% of the patient's body weight, with the focus of the sessions on standing tolerance and ambulation. These sessions showed immediate carryover to over-ground ambulation of 75' with the wheeled walker outside of the DBWS system that week.

The next seven DBWS sessions focused on transfer training, standing tolerance, longer distance ambulation for endurance and functional mobility, and stair training. Body weight offloading was dynamically regulated during practice of sit-to-stand, standing-pivot-transfers, ambulatory trials, and stair training. Initial practice with sit-to-stand was accomplished using the DBWS ascent assist feature. This allowed for rapid automatic increases

Table 1. Vector Sessions and Associated Patient and Session Metrics[a]

Vector Session	1	2	3	4	5	6	7	8	9
Day of Hospitalization	5	9	11	16	19	23	25	30	32
Oxygen Support	Vent	Vent	Trach Collar, 2-3L	Trach Collar, 4L	Trach Collar, 2L	Trach Collar, 3L	Trach Collar, 4L	Trach Collar, 3L	Trach Collar, 3L
Total Time Up (min:sec)	22:51	29:29	26:31	25:28	36:20	30:51	29:59	33:35	40:39
Total distance ambulated (ft)	225.9	352	325.5	290.2	370.7	204.0	387.3	322.3	567.5
Average BW Offloading (%)	18%	19%	15%	14%	15%	14%	12%	11%	10%
TUG (sec)	53	44.8	-	-	-	46	41	-	41
Borg (6-20)	13	15	15	-	11	12	13	15	15

[a]Abbreviations: BW, body weight; ft, feet; L, liters; min, minutes; sec, seconds; trach, tracheostomy; TUG, timed up and go; vent, ventilator.

in offloading if the patient was unsuccessful during the sit-to-stand activity at the set level of offloading. The patient received supplemental oxygen via tracheostomy collar at a fraction of inspired oxygen (FiO2) of 28%-36%, tolerating upwards of 40 minutes of training time, only off-loading an average of 10% of the patient's body weight, and ambulating over 500' with the wheeled walker. The patient was discharged to subacute care and was subsequently lost to follow-up. St. Joseph's Health / St. Peter's Health Partners Institutional Review Board (IRB) determined this case report to be exempt from IRB review. The patient has provided written consent for this case report.

Outcomes

Patient outcomes included an increased ambulation distance from 226' during the first Vector session to 568' during the last (Table 1). From the first to last session, offloading decreased from an average of 30% to 17%, and the Timed Up and Go (TUG) improved from 53 seconds to 41 seconds. Upon discharge, the patient required ventilation at night but was tolerating 35% FiO2 via tracheostomy collar during the daytime. For functional mobility assessed using section GG of the CMS Inpatient Rehabilitation Facility Patient Assessment Instrument, upon admission the patient was dependent for bed mobility and transfers, was non-ambulatory, and could not complete static or dynamic standing assessments. Upon discharge, the patient could complete bed mobility with minimal assist of one, transfers with contact guard assist of one, could ambulate overground 160' with a wheeled walker and contact guard assist of one, could negotiate four stairs with bilateral rails and minimal assist of one, and completed 5 minutes of static standing with contact guard assist of one for both static and dynamic standing. Across Vector sessions, the patient experienced mild fatigue as an adverse event following the sessions due to increased exertion. During the second and seventh sessions, the device detected one fall prevented per session.

Discussion

This case report presents the use of a DBWS system for safe mobility practice in a mechanically ventilated patient. Following evaluation, the patient requiring mechanical ventilation could participate in a structured rehabilitation program incorporating DBWS training. Before DBWS was used with this patient, the inpatient rehabilitation facility established clinical guidelines and practiced emergency procedures to ensure successful therapy sessions while minimizing risk.

To our knowledge, the use of DBWS in the rehabilitation of a mechanically ventilated patient has not been previously described. As the patient's strength and walking ability improved, adjustable Vector settings and features including ascent assist and gait smoothing allowed for safe reduction in offloading assistance with patient progression. DBWS also permitted ambulatory practice with a single therapist, making therapy sessions less resource intensive.

While this case suggests that DBWS systems may offer benefits for patients experiencing significant debility following prolonged ICU stays with mechanical ventilation, these findings should be interpreted with caution and require further validation in a larger study. For this population, there are several potential benefits of DBWS-based mobility training versus standard gait training, including less constrictive upper body support, decreased staff assistance needed to mobilize patients, ability to increase off-loading without increased patient or staff safety risk, and reduced fall risk. In this case, the DBWS system appeared to play a role in mitigating further deconditioning and improving the patient's motor function with safe gait training practice. The patient also demonstrated improved confidence when ambulating and increased over-ground ambulation distance immediately following the first DBWS session.

Most studies in DBWS gait training have been performed in individuals recovering from neurological conditions; however, the features of DBWS systems lend themselves to patient populations recovering from a range of critical illnesses. While this single case in a mechanically ventilated patient demonstrates feasibility and safety, minimal functional data upon discharge and loss to follow-up limit the ability to analyze functional improvements and durability of outcomes. Further studies are needed to evaluate the broader applicability, optimal protocols, and long-term benefits of DBWS in currently or previously ventilated patients, including randomized controlled trials to better define its role in critical care rehabilitation.

Acknowledgements

None.

Funding Information

Self-funded by the James A. Eddy Research Institute, Sunnyview Rehabilitation Hospital, Schenectady, NY.

Conflicts of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, or publication of this article.

References

1. Parry A. Importance of early mobilisation in critical care patients. Br J Nurs. 2016 May 12-25; 25(9): 486-8.
2. Adler J, Malone D. Early mobilization in the intensive care unit: a systematic review. Cardiopulmonary Physical Therapy Journal. 2012 Mar; 23(1): 5-13.
3. Parry S, El-Ansary D, Cartwright M, et al. Ultrasonography in the intensive care setting can be used to detect changes in the quality and quantity of muscle and is related to muscle strength and function. J Crit Care 2015 Oct; 30(5): 1151–e1159.
4. Fan E, Dowdy D, Colantuoni E, et al. Physical complications in acute lung injury survivors: a 2-year longitudinal prospective study. Crit Care Med. 2014 Apr; 42(4): 849-59.
5. Hermans G, Van Mechelen H, Van den Berghe G (2014), et al. Acute outcomes and 1-year mortality of intensive care unit-acquired weakness—a cohort study and propensity-matched analysis. Am J Respir Crit Care Med. 2014 Aug 15; 190(4): 410-20.
6. Li A, Peng X, Zhu B, Zhang Y, Xi X. Active mobilization for mechanically ventilated patients: a systematic review. Archives of Physical Medicine and Rehabilitation. 2013; 94(3): 551-561.
7. Singam A. Mobilizing Progress: A Comprehensive Review of the Efficacy of Early Mobilization Therapy in the Intensive Care Unit. Cureus. 2024 Apr 4; 16(4): e57595.
8. Doiron KA, Hoffmann TC, Beller EM. Early intervention (mobilization or active exercise) for critically ill adults in the intensive care unit. Cochrane Database Syst Rev. 2018 Mar 27; 3(3): CD010754.
9. Perme C., & Chandrashekar RK. Managing the Patient on Mechanical Ventilation in ICU: Early Mobility and Walking Program. Acute Care Perspectives. 2008 Jan 01; 17(1): 10-15.
10. Hodgson CL, Stiller K, Needham DM, et al. Expert consensus and recommendations on safety criteria for active mobilization of mechanically ventilated critically ill adults. Crit Care. 2014 Dec 4; 18(6): 658.
11. Zhang C, Wang X, Mi J, et al. Effects of the High-Intensity Early Mobilization on Long-Term Functional Status of Patients with Mechanical Ventilation in the Intensive Care Unit. Crit Care Res Pract. 2024 Mar 22; 2024: 4118896.
12. Perlow E, Tunney N, Lucado, A. Integrating safe patient handling into physical therapist education: reducing the incidence of physical therapist injury and improving patient outcomes. Journal of Physical Therapy Education. 2016; 30(2): 32-37.
13. Huber J, Elwert N, Powell ES, et al. Effects of dynamic body weight support on functional independence measures in acute ischemic stroke: a retrospective cohort study. J Neuroeng Rehabil. 2023 Jan 16; 20(1): 6.
14. Jourdan C, Pradalier F, Chalard K, et al. Body-weight support gait training in neurological intensive care: safety, feasibility, and delays before walking with or without suspension. J Neuroeng Rehabil. 2023 Dec 13; 20(1): 167.
15. Jiang Z, Zhang X, Fu Q, Tao Y. Effects of body weight support training on balance and walking function in stroke patients: a systematic review and meta-analysis. Front Neurol. 2024 Aug 27; 15: 1413577.
16. Yang FA, Chen SC, Chiu JF, et al. Body weight-supported gait training for patients with spinal cord injury: a network meta-analysis of randomised controlled trials. Sci Rep. 2022 Nov 10; 12(1): 19262.
17. Arroyo-Fernández R, Menchero-Sánchez R, Pozuelo-Carrascosa DP, et al. Effectiveness of Body Weight-Supported Gait Training on Gait and Balance for Motor-Incomplete Spinal Cord Injuries: A Systematic Review with Meta-Analysis. J Clin Med. 2024 Feb 15; 13(4): 1105.