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Rehabilitation Using Dynamic Body Weight Support After Multiple Trauma

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Abstract

Traumatic injuries involving multiple body systems present unique challenges to traditional rehabilitative approaches. There is limited evidence informing effective rehabilitation strategies for patients with complex multi-system conditions. This case report describes how a dynamic body weight support (DBWS) system assisted in the rehabilitation of a 73-year-old woman with multiple trauma following a motor vehicle strike. Multiple injuries were sustained, including fractures of the upper and lower extremities, ribs and pelvis. The patient was unable to mobilize while maintaining weightbearing precautions without the assistance of 2-3 skilled therapists. Trials of DBWS allowed for safe practice of sit-to-stand, transfers, and ambulation, while maintaining all precautions. DBWS was well tolerated by the patient, and allowed for significant mobility gains during inpatient rehabilitation. This report details the first trials of DBWS in a patient with multiple trauma. Given the variability of medical considerations in patients with multiple injuries, interdisciplinary collaboration between rehabilitation therapists and orthopedic surgical teams can help inform rehabilitation strategies. In cases where patients have conflicting weightbearing precautions, the use of dynamic body weight support systems can facilitate safe mobilization while ensuring adherence to set precautions.

Introduction

Unintentional injuries are the third leading cause of death in the United States[1], with motor vehicle accidents accounting for over 40,000 deaths and 2.7 million injuries annually[2]. Over the past 35 years, mortality rates have decreased in patients with multiple trauma, a combined result of increased safety legislation (e.g., seatbelts, helmets), and improvements in trauma care[3]. Survivors face numerous challenges, and many require rehabilitation prior to returning to the community.

Clinical trials during the rehabilitation phase of recovery are sparse due to the diversity of medical complications and injuries sustained[4]. In the initial stages of recovery, patients can require multiple surgeries, leading to prolonged hospitalizations resulting in muscle weakness and other secondary complications (e.g, pressure injuries, pneumonia, infections)[5]. Strategies to improve patient independence with mobility are often in the context of pain, muscle weakness, weight-bearing precautions, oxygen requirements, and/or cognitive impairments. A recent systematic review highlighted a gap in evidence informing effective rehabilitation strategies for patients with multiple trauma[6]. Traditional rehabilitation methods are often limited to supine and seated therapeutic exercises, use of full manual lifts, or slide board transfer training for out-of-bed mobility, and initiation of standing tolerance and pre-gait activities using parallel bars.

Body weight support (BWS) systems allow patients with lower limb weakness or balance impairments to safely participate in rehabilitation with greater independence. In recent years, BWS systems have evolved to include ceiling-mounted robotic trolley systems with dynamic weight offloading. While these systems can be costly for facilities, dynamic body weight support (DBWS) systems allow patients to participate in more varied therapies (e.g., sit-to-stand, transfers, and stairs) by keeping weight unloading within a prespecified range as patients shift their center of mass. DBWS systems have been trialed in patients with stroke[7], spinal cord injury[8,9], brain injury[10], and mechanical ventilation[11] with favorable outcomes. Patients with multiple trauma and impaired mobility may benefit from DBWS, but no studies have been conducted to date.

Case History

A 73-year-old female, with a BMI of 35.89kg/m^2, was admitted to a Level 1 trauma unit, after being struck by a motor vehicle. The patient presented with shortness of breath, significant chest and back pain, with bilateral small pneumothorax. She sustained multiple injuries, including anterior dislocation of the right humeral head with a Hill-Sachs deformity, multiple fractures, including displaced left and right coracoid processes, right displaced distal radius, multiple ribs (displaced 1-3 and 6-8, nondisplaced 4-5 on the left, nondisplaced 2-4 and displaced 5-8 on the right), right superior and inferior displaced pubic rami with fracture extending into the pubic body, right and left sacral alla, displaced left iliac bone, sacroiliac joint widening and left talus.

Fractures of the pelvic ring, radius, and left ribs (3-7) were stabilized by reduction and internal fixation, with cryoablation in the left intercostal region to manage pain. A closed reduction of the right shoulder was also completed. While hospitalized, the patient developed acute respiratory distress, with worsening pulmonary contusions requiring ventilation, and ultimately tracheostomy after failing extubation. Prior to injury, the patient had a history of anxiety, depression, hypertension, osteoarthritis, spinal stenosis, and had undergone three laminectomies and a total knee arthroplasty; none of which appeared to be barriers to her recovery. She was completely independent with functional mobility at baseline.

Following a 22-day hospitalization, the patient was admitted to an inpatient rehabilitation facility. Upon admission she required the assistance of two skilled therapists for bed mobility and had limited tolerance for sitting and standing. Manual muscle testing revealed impaired strength and reduced range of motion in both the right and left lower extremities. Early rehabilitation goals were focused on improving out-of-bed tolerance. Transfers were accomplished using a Hoyer or ceiling lift.

Therapy interventions included occupational therapy to address limitations in activities of daily living, functional reaching tasks, and balance training, speech and language therapy for respiratory muscle training and swallowing, and physical therapy for functional transfer and mobility training, strength and balance exercises. Initial ambulatory trials had limited success. The patient was unable to use a walker due to lower extremity weakness and multiple weight bearing precautions, including protected weight bearing with a walker for her left lower extremity, and non-weight bearing status for her right arm. Her ability to advance her left lower limb was limited by significant pain and lower extremity weakness, along with the additional weight of a controlled ankle movement (CAM) boot. Mobilization required 2-3 staff members to assist the patient in maintaining weight bearing precautions and with advancement of the left lower limb. Conventional gait-assistive technologies (e.g. Rifton Tram, Sara Lift) did not allow the patient to maintain her non-weight bearing restrictions on her right upper extremity.

Due to those limitations, the patient was cleared to trial Vector Gait and Safety System DBWS (Bioness), 26 days post injury, following a discussion with the orthopedic surgery team. She completed three sessions with DBWS. The patient tolerated the harness, which was minimally compressive to the trunk, with little impact on shoulder positioning. Importantly, the harness allowed space for the patient's casted right arm (with sling), such that non-weight-bearing precautions were maintained (Figure 1 and 2). Protected weight-bearing precautions in the CAM boot were accomplished with an average of 21-33% body weight offloading by the DBWS system (Table 1) and the use of a hemi-walker. Body weight offloading was dynamically regulated during practice of sit-to-stand, standing-pivot-transfers and ambulatory trials. Initial practice with sit-to-stand was accomplished using the DBWS ascent assist feature. This allowed for rapid automatic increases in offloading if the patient was unsuccessful during sit to stand activity at the current set weight offloaded.

During ambulatory trials, the height of the CAM boot artificially increased the length of the left leg, resulting in an asymmetric gait pattern. Vertical displacement was reduced using an EVENup shoe lift in the right sneaker. Automatic adjustments to body weight support during ambulation were accommodated using the Vector gait smoothing feature; excessive vertical displacement initiated an automatic increase in body weight support, providing the patient with additional support when attempting to advance her left leg with the CAM boot. Additionally, vertical displacement below a prespecified range reduced offloading, allowing the patient to support more of her own body weight using her right leg, and hemi-walker on the left side. Reduction in offloading was limited to 2/3 of the initial setting, which also helped ensure weight bearing precautions were maintained. The gait smoothing feature, with the addition of the shoe lift and hemi-walker improved quality of gait, and increased tolerance for the activity while safely maintaining weight bearing precautions. While supported, a single therapist helped with weight shifting and advancement of the left lower leg. This allowed for the patient to make functional gains in ambulation, with reduced staff involvement (Table 2).

After 22 days at inpatient rehabilitation, the patient could transfer between a bed and a chair and walk 25 feet with contact-guard assistance. She was able to maintain standing balance for 3 minutes. She was discharged to a subacute rehabilitation facility for continued rehabilitation. After 2 months in the subacute rehabilitation facility, she

Figure 1. Dynamic body weight support assisted rehabilitation of a patient with multiple trauma

Figure 2. Patient Harness:
(A) Shoulder straps and (B) top torso support were accommodating of sling and permissive to practice with assistive device. (C) Upper abdominal support was minimally compressive to trunk, and offered flexibility around ribcage. (D) Lower abdominal support distributed weight primarily through pelvis and lower abdomen (E) Leg supports

underwent a right reverse total shoulder arthroplasty to address her injury from the accident. She returned to the subacute rehabilitation facility for an additional month before returning home, where she participated in physical therapy for her shoulder.

Conclusion and Results

The DBWS system enabled safe mobility practice in a patient hospitalized for multiple traumatic injuries,

Table 1. Dynamic Body Weight Support Session Information.

	Session 1	Session 2	Session 3
Total Time Up (min)	13:00	9:36	27:32
Total distance ambulated (ft)	77	42	262.2
Average offloading (lbs/%)	59/33%	38/21%	41/23%
Maximum offloading (lbs/%)	91/51%	42/24%	61/34%
Session Focus	Sit to stands and initiation of ambulation with max assistance for weight shift and limb advancement	Progression to stand pivot transfers with a hemi-walker	Transfer training with ascent assist and ambulation with the hemi-walker

Table 2. Functional Changes During Inpatient Rehabilitation for Multiple Trauma

	Admission	Discharge
Rolling L/R	Not attempted, medical/safety	Partial/Moderate
Sitting to Lying	Not attempted, medical/safety	Partial/Moderate
Lying to Sitting	Not attempted, medical/safety	Supervision or Touching
Sit to Stand	Not attempted, medical/safety	Supervision or Touching
Chair/Bed Transfer	Dependent	Supervision or Touching
Toilet Transfer	Dependent	Partial/Moderate
Car Transfer	Not attempted, medical/safety	Partial/Moderate
Walking 10 feet	Not attempted, medical/safety	Supervision or Touching
Walking 50 feet	Not attempted, medical/safety	Not attempted, medical/safety
Sitting Balance	Not attempted	Supervision or Touching, 60 minutes with rest break
Standing Balance	Not attempted	Supervision or Touching, 3 minutes
Walking distance	0 feet	25 feet

with weight bearing precautions of the upper and lower extremities. Due to the nature of injuries, traditional body weight support devices (parallel bars, walker, cane) were not sufficient to progress mobility, even with the help of multiple therapists. DBWS provided controlled regulation of offloading to safely maintain precautions. As the patient gained strength, adjustable Vector settings, and features including ascent assist and gait smoothing, allowed for safe and appropriate progression. Furthermore, DBWS allowed for ambulatory practice with a single therapist, better enabled to focus assisting the patient with weight shifting and leg advancement while reducing risk of injury from manual positioning and lifting.

The use of DBWS in the rehabilitation of a patient with multiple trauma has not been previously described. Many body weight support systems are not appropriate for patients with multiple trauma, due to the nature of injuries sustained. Often body weight harnesses have lateral supports that are constricting through the rib cage, or upper extremity supports that do not accommodate slings or allow practice with an assistive device. The harness allowed for body weight support primarily through the pelvis and lower abdomen, with flexible material surrounding the rib cage. Less constrictive upper body support, including over the shoulder straps, allowed space for sling, and use of a hemi-walker.

This study is limited by the number of DBWS sessions the patient was able to complete during her rehabilitation stay. DBWS sessions were not initiated until day 12 of the rehabilitation program following improvement of out-of-bed tolerance, trials of alternative strategies to promote mobilization, and clearance from the orthopedic surgical team.

DBWS had a significant impact on recovery of a patient with multiple trauma, enabling trials of both mobility and ambulation under highly controlled and dynamic bodyweight support. Improved control and monitoring of bodyweight offloading, allowed for increased comfort and safety of both the patient and treating therapist, as well as improved mobility. Clinicians should consider DBWS systems in the rehabilitation of patients with multiple trauma requiring additional physical support. Patients with upper extremity precautions who are unable to make use of traditional support devices may particularly benefit, particularly when with upper body precautions interfere with the ability to comply with lower body precautions. However, injuries and precautions following traumatic injuries vary widely, and cases should be reviewed by a medical team, prior to trialing DBWS. Unstable fractures, and halo neck supports are contraindications for use.

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Conflicts of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

St. Joseph's Health / St. Peter's Health Partners Institutional Review Board (IRB) determined this case report to be IRB exempt. Written informed consent for the use and disclosure of clinical information and photographic material was obtained from the patient.

References

1. Centers for Disease Control. Mortality Data. 2022 [24 Sept 2025, 25 July 2024]. Available from: https://www.cdc.gov/nchs/nvss/deaths.htm.

2. The American Association for the Surgery of Trauma. Trauma Facts. Chicago, IL, USA. [n.d; 25 July 2024] Available from: https://www.aast.org/resources/trauma-facts.

3. van Bruegel JMM, Niemeyer, MJS, Houwert RM, et al. Global changes in mortality rates in polytrauma patients admitted to the ICU – a systematic review. World J Emerg Surg. 2020; 15(15): 1-13. https://doi.org/10.1186/s13017-020-00330-3.

4. Hanna RA, Amatya B, Lizama LE, et al. Multidisciplinary rehabilitation in persons with multiple trauma: A systematic Review. J Rehabil Med. 2020; 50(10): 1-9. https://doi.org/10.2340/16501977-2737.

5. Dasdar S, Yousefifard M, Ranjbar MF, et al. Frequency of posttrauma complications during hospital admission and their association with Injury Severity Score. Clin Exp Emerg Med. 2023; 10(4): 410-417. https://doi.org/10.15441/ceem.23.053.

6. Klingebiel F K-L, Landre V, Hasegawa M, et al. The three stages of polytrauma rehabilitation – a recommendation and a systematic literature review on behalf of SICOT. Int Orthop. 2024; 49(2): 365-374. https://doi.org/10.1007/s00264-024-06385-0.

7. 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; 6: 1-9. https://doi.org/10.1186/s12984-023-01132-9.

8. Powell ES, Lopez J, Westgate PM, et al. Effects of dynamic overground body weight support training during inpatient rehabilitation after traumatic spinal cord injury: A retrospective case series. Am J Phys Med Rehabil. 2022; 101 (2): 196-200. http://doi.org/10.1097/PHM.0000000000001828.

9. Huber JP, Sawaki L. Dynamic body-weight support to boost rehabilitation outcomes in patients with non-traumatic spinal cord injury: an observational study. J Neuroeng Rehabil. 2020. 17: 157. http://doi.org/10.1186/s12984-020-00791-2.

10. Anggelis E, Powell ES, Westgate PM, et al. Impact of motor therapy with dynamic body-weight support on Functional Independence Measures in traumatic brain injury: An exploratory study. Neurorehabilitation. 2019; 45(4): 519-524. http://doi.org/10.3233/NRE-192898.

11. Haught M, Bodine JK, Khan AY, et al. Dynamic Overground Body Weight-Supported Gait Rehabilitation in a Mechanically Ventilated Patient. J Rehab Therapy. 2025; 8(3): 4-8. http://doi/10.29245/2767-5122/2025/3.1164.