

Effect of Body Weight Supported Treadmill Training (BWSTT) to Improve Gait Efficiency in Persons with Below Knee Amputations: A Retrospective Case Report

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Introduction

- As of 2005, it is estimated that nearly one in 190 people in the United States were living with the loss of a limb, equaling 1.6 million people¹.
- Researchers predict that this number is likely to grow to 3.6 million by the year 2050¹.
- There are several functional limitations that correspond with lower extremity amputation; one of the most important functional limitations is the inability to ambulate².
- BWSTT has been used with various populations, and studies have demonstrated that improvements in gait found during BWSTT translated into improved over ground ambulation and endurance^{3,4}.
- The purpose of this case report was to describe traditional PT following a trans-tibial amputation and explore the benefits of BWSTT to improve gait efficiency

Case Description

- 73 year-old male with a chief impairment in his ability to stand and walk following a TTA one a half months prior to being evaluated.
- Past medical history (PMH), which includes cardiovascular disease, hypertension (HTN), peripheral artery disease (PAD), insulin dependent diabetes mellitus (IDDM) and lymphoma
- Surgical history includes a quadruple coronary artery bypass graft (CABGx4), right 5th toe amputation, an implanted cardiac defibrillator, and an amputation of left foot with a subsequent revision and proximal TTA .
- Received a pin and lock trans-tibial socket following the TTA, however experienced difficulty donning due to increased residual limb volume and impaired integumentary integrity.

Initial Examination

- Completed in the home health setting, with the patient sitting in his wheelchair with his residual limb resting in knee flexion.
- The distal residual limb had a small blister proximal to the suture line, with reported intermittent pain 1 to 3/10.
- ROM and strength testing shown in table 1 and 2.
- Standardized outcome measures unable to be obtained due to inability to don prosthesis.
- Able to demonstrate bed mobility and transfers without assistance but with mild safety concerns, including hand placement and weight shifting
- Recommended 10 week POC seen 3 times per week.
- Established goals set to promote improvements in posture, improved knowledge of prosthetic device management, increased balance and overall safety with ambulation and increased independence with ambulation for community distances with the least required A.D.

Interventions

- Based on the initial evaluation, the treating PT determined a problem list to direct interventions (table 3).
- Interventions to address the mentioned problem lists included:
 - Lumbo-pelvic and core stabilization
 - Seated and standing therapeutic exercise including mini squats, quadriceps stets, hip extension and hip abduction.
 - Static and dynamic balance activities including eyes open and closed progression with altered base of support and manual perturbations. Progressions included moving the center of mass outside the base of support and altering the surface to be more compliant.
 - Balance reactions were addressed with weight shifts, stepping in place with appropriate pelvic rotations and turning in place.
 - Gait training began with minimal distance using a 2 wheeled walker indoors on even surfaces. Distance were increased per patient tolerance, as well as reduction from a walker to a single point cane. Training moved to outdoor, uneven terrain with the patient ultimately ambulating distances of 450 feet with a single point cane.
- Interventions were limited by distal residual limb discomfort in the socket and lower back pain. Each session lasted 45 to 60 minutes in duration over a 10 week period for a total of 30 treatment sessions

Outcomes

- As seen in tables 1,2, and 4, the patient improved in areas of active range of motion, strength, and decreased his overall risk for falls.
- He was able to ambulate distances of 450 feet with a single point cane indoors and outdoors independently.

Table 1
Strength at Initial Evaluation vs. Discharge

Motion	IE: 10/11/16		DC: 1/16/17	
	Right	Left	Right	Left
General spine	4/5	4/5	4/5	4/5
Upper Extremity	4/5	4/5	4/5	4/5
Hip Flexion	3+/5	3+/5	4/5	4/5
Hip Extension	4/5	4-/5	4+/5	4+/5
Hip Abduction	4/5	4/5	4+/5	4+/5
Knee Flexion	4+/5	4/5	4+/5	4+/5
Knee Extension	4+/5	4/5	4+/5	4+/5
Dorsiflexion	4/5		4/5	
Plantar flexion	4/5		4/5	

Table 3
Defined Problem List

1. Strength and endurance deficits limiting functional activity
2. Decreased postural strength and awareness
3. Decreased balance and a risk for falling
4. Pain limiting functional activities
5. Decreased knowledge of home exercises
6. Decreased use of prosthetic device to promote improvements in gait and maintain carryover
7. Decreased ability to ambulate in the community

Table 2
AROM at Initial Evaluation vs. Discharge

Motion	IE: 10/11/16		DC: 1/16/17	
	Right	Left	Right	Left
General spine	WFL	WFL	WFL	WFL
Upper Extremity	WFL	WFL	WFL	WFL
Hip Flexion	WFL	WFL	WFL	WFL
Hip Extension	NT	NT	NT	NT
Hip Abduction	WFL	WFL	WFL	WFL
Knee Flexion	WFL	WFL	WFL	WFL
Knee Extension	WFL	-10 deg	WFL	-10 deg
Dorsiflexion	WFL		WFL	
Plantar flexion	WFL		WFL	

Table 4
Functional Outcome Measures

Outcome	IE: 10/11	PN: 11/2	PN: 11/23	PN: 12/14	DC: 1/16
TUG	NT	34 sec w/ RW	20 sec w/ cane*	18.8 sec w/ cane	19 sec
Tinetti	NT	18/28	18/28	23/28*	NT
5x STS	NT	26 sec	19 sec	19 sec	23 sec

IE: Initial Evaluation; PN: Progress note; DC: Discharge
NT: Note Tested; RW: Rolling Walker
* Denotes minimal detectable change (MDC) met

Discussion

- Benefits of traditional physical therapy interventions were demonstrated through follow-up assessment and measured using objective tests.
- The improvement in strength in the lower extremities, most notably in the hip and knee musculature in the left leg, were needed in order to progress to an improved gait pattern with the least amount of assistance required.
- These improvements allowed for an improved gait pattern utilizing a step through pattern and only requiring the use of a single point cane, which ultimately improved the patients overall independence.
- Although gait training was progressed to longer distances, endurance remained an issue for this patient.
- BWSTT, specifically with the Alter G treadmill, could have been used to allow for prolonged ambulation to improve endurance⁵.
- The Alter G allows for ambulation under gravity reduced conditions, while eliminating the risk for falls, to learn the proper recruitment patterns for normalized gait without drag forces or a restricting harness system⁶.
- Multiple case studies have indicated that BWSTT could be a significant benefit to the rehabilitation of people affected by lower limb amputations with improvements in the 6-minute walk test, TUG, and other validated outcome measures, while reducing the need for an assistive device^{7,8}.
- With the supportive initial research, the Alter G may have been beneficial to this particular patient.
- Further research with the treadmill should be completed to validate these potential benefits and to potentially establish a protocol for the use of the Alter G treadmill with those affected by lower extremity amputations.

Conclusions

- This case demonstrated a very typical clinical presentation following a TTA due to vascular reasons.
- The patient made significant progress with functional mobility during the 10 weeks of interventions achieving all established goals.
- Increased benefits may have been achieved with the use of BWSTT for prolonged ambulation time and associated improvements in cardiovascular fitness and endurance.
- Limitations of this case report that made conclusions about the effectiveness of the intervention difficult included limited detail in AROM, specifically hip extension, the lack of outcome measures validated for this specific population, and limited availability of equipment in the home health setting.

References

- See handout for reference list