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Case Report Open Access

Effect of Free Swing Gait Training on Back Pain in a Patient with Bilateral Lower Extremity Amputations: A Case Report

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Abstract

Introduction: Back pain is a common occurrence in persons with a lower extremity amputation, and can cause a chronic disability. Early physical therapy interventions of gait training with prosthesis could prevent amputees from becoming disabled by chronic back pain. Free swing gait training is sometimes utilized in physical therapy with transfemoral amputees learning to use prosthesis. However, there is a lack of evidence for the benefits of free swing gait training on decreasing back pain.

The purpose of this study is to describe the effect of free swing gait training on low back pain in an amputee.

Case Description: The patient was a 57 year old Caucasian male with a history of a left transtibial amputation and a recent right transfemoral amputation. He was referred to physical therapy to learn how to utilize his new transfemoral prosthetic and find functional independence as a bilateral amputee. One of his chief complaints was debilitating low back pain that had increased since his latest amputation.

Intervention: Physical therapy intervention included free swing gait training intended to normalize the patient's gait pattern while ambulating with a left transfemoral and a right transtibial prostheses. It was hypothesized that the normalization of the patient's gait pattern would decrease his complaint of back pain.

Results: After 8 weeks of physical therapy, including 3 weeks of free swing gait training, the patient demonstrated decreased low back pain, increased strength, and improved gait quality and distance.

Discussion: The results of this case report demonstrate that the use of free swing gait training can be beneficial to decrease back pain in a bilateral amputee.

Keywords: Case report; Transfemoral amputee; Free swing gait training; Back pain; Rehabilitation

Introduction

Dysvascular disease accounts for up to 54% of amputations in the United States [1]. Of those with dysvascular amputations, 74% have a comorbidity of diabetes [2]. With the increase in prevalence of dysvascular disease and diabetes, it is expected that the number of persons with limb loss will also increase [2]. Among persons with an initial transtibial amputation due to dysvascular disease, there is a 9% likelihood of requiring a contralateral amputation within a 12-month period; diabetic amputees being more likely than nondiabetic amputees [3]. Rehab professionals must assess how these limb losses will affect functional mobility and prevalence of back pain in persons with amputations.

Most amputees exhibit multiple primary and secondary impairments as a result of their limb loss. These impairments may include decreases in strength, proprioception, and balance; as well as gait deviations and pain [4-7]. These patients are often referred to physical therapy in order to address their physical impairments and to obtain independence with prosthetic use during ambulation. During rehabilitation, an amputee learns how to compensate for deterioration of sensorimotor function in both the intact leg and residual limb [8].

At the proximal level of amputation there may also be increased changes in muscle morphology [9]. With prosthetic use during ambulation, abductor muscle force during the stance phase and adductor muscle force during the swing phase is decreased compared to a healthy person's gait [10]. This can lead to the presence of pelvic obliquities and an unstable gait pattern [10]. In the older amputee population, this unstable gait pattern can also lead to feelings of insecurity and fear, causing a reduced gait speed [10]. Additionally, amputees with an adaptive gait pattern spend more time on the intact limb due to increased proprioception and balance when compared to the residual limb, leading to pain in other joints [4].

Back pain is a common occurrence in persons with a lower extremity amputation and can cause a chronic disability if not addressed [4]. According to Edhe et al., 52% of the transfemoral amputee participants in their study experienced persistent low back pain [5]. Problems with the prosthetic socket fit and prosthetic alignment can also have an effect on low back pain [4]. For example, a leg length discrepancy resulting in a hip hike during ambulation makes the amputee more susceptible to secondary low back pain symptoms.

Early prosthetic gait training and postural muscle exercises have the potential to prevent amputees from becoming disabled by chronic back pain [7]. Free swing gait training is a technique sometimes utilized by physical therapists during treatment of transfemoral amputees learning to use prosthesis. This method of gait training includes unlocking the knee component of the prosthesis and leaving it unlocked throughout ambulation. The patient places weight through the toe component of the prosthesis during the terminal stance of gait in order to release the knee component and allow the leg to swing through.

The patient then places his or her weight through the heel during the initial contact phase of gait, in order to stabilize the unlocked knee component. Ambulation with an unlocked prosthesis requires the patient to exhibit confidence in his or her balance capabilities and be able to control where his or her weight is being placed throughout the gait cycle. Free swing gait training has the potential to reduce the number of gait deviations a transfemoral amputee would normally adopt during ambulation.

An extensive search of literature was performed through PubMed and ProQuest, using the key terms "transfemoral amputee", "back pain", and "free swing gait training" to identify cases or research on the effect of this technique on secondary conditions. To date, there is no research on the effectiveness of free swing gait training in relation to secondary impairments of amputees. The purpose of this study is to describe the effect of free swing gait training on low back pain in a bilateral amputee.

Case Description

The patient was a 57 year old Caucasian male with a history of cardiovascular disease and diabetes. As a result of a chronic wound on the bottom of his right foot, he received a right transtibial amputation. One year later, he underwent a transfemoral amputation on his left lower extremity after three failed surgical attempts to increase blood flow to save the limb. He was referred to physical therapy after 10 weeks of occupational therapy for upper extremity strengthening, to learn how to utilize his new transfemoral prosthesis.

Prior to his second amputation, the patient was able to ambulate without an assistive device using his right transtibial prosthesis. At the initiation of physical therapy, he was using a standard wheelchair for mobility and was unable to ambulate independently using bilateral prostheses. The patient's goal for physical therapy was to be able to walk with both his right transtibial and left transfemoral prostheses using a cane.

The initial physical therapy examination, showed decreased strength in bilateral lower extremities as measured by manual muscle testing (Table 1). Manual muscle testing has been shown to be a reliable and valid measure when employed by physical therapists [11]. Rhomberg balance testing revealed a decrease in static standing balance using bilateral prostheses without the use of an assistive device. This decrease in balance can be attributed to decreased strength and proprioception in bilateral lower extremities. He reported pain in both shoulders and low back as 6/10, measured by the Numerical Rating Scale, which has been shown to be a valid and reliable measurement tool when used in the clinic [12].

The patient was able to walk 50 feet with assistance using a walker while wearing bilateral prostheses, but exhibited poor safety awareness. Gait analysis of the left lower extremity (transfemoral prosthesis) revealed a left hip hike and increased step length with mild circumduction during swing phase. During right lower extremity gait analysis (transtibial prosthesis), the patient displayed increased time in stance phase resulting in an antalgic gait pattern. The patient's decreased muscular strength and poor control in left hip musculature could have contributed to these gait abnormalities, as mentioned in Table 2.

An Outpatient Physical Therapy Improvement in Movement Assessment Log (OPTIMAL) was administered to assess the patient's self-confidence when performing different functional activities [13]. He scored a 34/60 on the initial OPTIMAL form, indicating he felt approximately sixty percent impaired with his ability to perform daily activities in his home and in the community.

During the initial weeks of physical therapy, interventions were primarily focused on improving the patient's strength, and balance through neuromuscular re-education therapeutic exercise, and traditional gait training. The patient initially began gait training with the left transfemoral prosthesis in a "locked" position for safety and to progress the residual limb's ability to bear weight through the prosthesis. Using this method, the patient improved with functional independence in ambulation using the knee component of his left transfemoral prosthesis in the locked position. Although he was able walk 150 ft with assistance using a rolling walker, he continued to report 6/10 pain in his low back during and after ambulation, which limited his motivation for walking.

At the end of week 5, as the patient's balance improved, he was progressed to free swing gait training to improve his gait pattern and decrease his low back pain. It was hypothesized that the increased left hip hike and circumduction exhibited during ambulation could be the cause of his low back pain. The knee component of the patient's left transfemoral prosthesis was switched to the unlocked position and the patient was instructed to apply weight through the toe aspect of his prosthesis during terminal stance to force the knee component to unlock and bend.

He was then instructed to swing his left prosthesis through and make initial contact with weight on the heel portion of his left prosthesis in order to straighten the knee component and place it in a stable position to accept weight for the stance phase. Free swing gait training was initiated in the parallel bars and then progressed to a walker. For a detailed list of the progression of interventions, including free swing gait progression, refer to Appendix A.

Results

At the time of discharge, the patient's OPTIMAL score decreased to 20/60, indicating he felt more confident being able to perform functional activities out in the community. Specifically, the patient showed improvement in the domains of walking short and long distances and balancing on the OPTIMAL outcome measure.

The patient's strength also improved, as outlined in Table 1. Additionally, he reported a decrease in bilateral shoulder and low back pain to 0/10 measured with the use of the Numeric Rating Scale. Gait analysis revealed improved ambulation distance to 300 feet without assistance with a rolling walker utilizing a free swing gait pattern. Table 2 compares initial evaluation and discharge outcome measures.

	Initial Evaluation			Discharge (8 weeks)	
Muscle Groups	**Right Lower Extremity**	**Left Lower Extremity**	**Muscle Groups**	**Right Lower Extremity**	**Left Lower Extremity**
Hip Flexors	4-/5*	4/5*	Hip Flexors	4+/5	4+/5
Gluteus Maximus	4-/5*	4/5*	Gluteus Maximus	04-May	4+/5
Gluteus Medius	4+/5*	4/5*	Gluteus Medius	4+/5	4+/5
Hip Abductors	4-/5*	4-/5*	Hip Abductors	04-May	04-May
Hip Adductors	4-/5*	4-/5*	Hip Adductors	04-May	04-May
Quadriceps	NA	5/5*	Quadriceps	NA	05-May
Hamstrings	NA	5/5*	Hamstrings	NA	05-May

Table 1: Initial evaluation and discharge manual muscle testing. *Without prostheses.

Outcome Measures	Initial Evaluation	Discharge (8 weeks)
Pain	Bilateral shoulder: 6/10	Bilateral shoulders: 0/10
	Low back: 6/10	Low back: 0/10
Ambulation distance and quality	50 feet with assistance, use of rolling walker, left hip hike and circumduction	300 feet without assistance, free swing pattern, use of rolling walker, no left hip hike or circumduction
OPTIMAL score	34/60	20/60

Table 2: Comparison of outcome measures at initial evaluation and at discharge.

The patient was unable to achieve his goal of ambulating independently using a cane. However, he was satisfied with the improvements he made, including independent ambulation with a rolling walker and decreased low back pain. He also reported that he was able to participate in more functional activities at home, such as assisting with chores, and felt more confident during ambulation than he did at the start of physical therapy, as evident by his increased OPTIMAL score.

Discussion

This case report describes how free swing gait training has the potential to decrease back pain and improve functional outcomes in bilateral amputees. Gait deviations of hip hike and circumduction seen in a typical amputee's gait pattern can lead to low back pain as mentioned in the article by Gailey [4]. In this case, free swing gait training was implemented to normalize the patient's gait pattern using his left transfemoral and right transtibial prostheses. As demonstrated, the free swing gait pattern succeeded in decreasing this patient's left hip hike and circumduction, ultimately eliminating the cause of his low back pain. Since this patient's low back pain did not dissipate until free swing gait training was implemented, it can be concluded that the patient's low back pain was eliminated by free swing gait training. This is the first report that establishes the benefits of free swing gait training in amputees for in reducing back pain.

Other factors may have contributed to the patient's positive outcome. Improvements in the patient's strength must also be considered. Typical amputees demonstrate an unstable gait pattern, resulting from weakness in hip musculature [10]. With strength training, the patient demonstrated a more stable gait pattern. Additionally, the use of balance interventions preceded gait training in order to prepare the patient to place equal weight through bilateral lower extremities. This could have had an effect on the patient's low back pain, as the article by Gailey states that increased stance time on the affected limb can cause back pain [4].

One limitation of this case study was that the OPTIMAL outcome measure has activities that amputees are not able to perform, such as kneeling and jumping. The OPTIMAL was useful in determining the patient's confidence level, which is essential to successful free swing gait, but another outcome measure may have been more appropriate. In this case, the patient was also a double amputee which could have skewed the results. The patient did not receive physical therapy after his right transtibial amputation; therefore he did have a slight decrease in hip musculature strength on the right side at initial evaluation (Table 1). Weakness in bilateral lower extremities likely had an effect on the patient's gait pattern during the initial evaluation.

Conclusion

With free swing gait training there is concern with regards to the safety of the patient. Ambulation with an unlocked prosthesis requires the patient to exhibit confidence in his or her balance capabilities and be able to control where his or her weight is being placed throughout the gait cycle. Decreased confidence and motivation to walk is a safety concern and should be considered before implementing free swing gait training. Future studies should focus on clinical trials of free swing gait training in single leg transfemoral amputees.

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