Does Perturbation Training Prevent Falls after Discharge from Stroke Rehabilitation? A Prospective Cohort Study with Historical Control

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Background: Individuals with stroke fall frequently, and no exercise intervention has been shown to prevent falls post stroke. Perturbation-based balance training (PBT), which involves practicing reactions to instability, shows promise for preventing falls in older adults and individuals with Parkinson's disease. This study aimed to determine if PBT during inpatient stroke rehabilitation can prevent falls after discharge into the community. *Methods:* Individuals with subacute stroke completed PBT as part of routine inpatient rehabilitation (n = 31). Participants reported falls experienced in daily life for up to 6 months post discharge. Fall rates were compared to a matched historical control group (HIS) who did not complete PBT during inpatient rehabilitation. *Results:* Five of 31 PBT participants, compared to 15 of 31 HIS participants, reported at least 1 fall. PBT participants reported 10 falls (.84 falls per person per year) whereas HIS participants reported 31 falls (2.0 falls per person per year). When controlled for follow-up duration and motor impairment, fall rates were lower in the PBT group than the HIS group (rate ratio: .36 [.15, .79]; $P = .016$). *Conclusions:* These findings suggest that PBT is promising for reducing falls post stroke. While this was not a randomized controlled trial, this study may provide sufficient evidence for implementing PBT in stroke rehabilitation practice. **Key Words:** Stroke—rehabilitation—accidental falls—postural balance.

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Introduction

Falls are a frequent medical complication during all stages of stroke recovery.[1] The risk of falling[2] and fall-related injury[3] is more than twice as high for people with stroke compared to similarly aged people without stroke. Individuals who have recently been discharged home after inpatient stroke rehabilitation are particularly vulnerable to falling.[1,4-6] Those who fall soon after discharge from inpatient rehabilitation have worse functional recovery at 6 months post discharge than those who do not fall,[7] possibly because the fall leads to fear and self-imposed activity restriction. Current treatment approaches likely do not adequately prepare individuals with stroke for the challenges they will face after discharge home to their "normal" lives.[8-10]

Physical exercise, particularly balance training, reduces fall risk among older adults.[11] However, traditional approaches to balance training do not prevent falls post stroke.[8,9] Falls happen due to failure to recover from a loss of balance.[12] Therefore, balance training that improves balance reactions might help prevent falls. Perturbation-based balance training (PBT), which involves exposing individuals to repeated postural perturbations,[13,14] is a novel exercise intervention that aims to improve control of balance reactions. Preliminary studies suggest that PBT almost halves fall rates among healthy older adults, older people with various diagnoses (including chronic stroke), and people with Parkinson's disease.[15]

This study aimed to determine the effect of PBT on fall occurrence after discharge home from inpatient stroke rehabilitation. Secondary objectives were to determine the effects of PBT on balance confidence, functional balance and mobility, and participation in daily physical activity. We hypothesized that, compared to a historical control group (HIS), the PBT group would report lower rates of falls and greater physical activity participation in the 6 months post discharge, and have greater improvements in balance confidence and balance and mobility function from admission to discharge from inpatient rehabilitation. We also report on the characteristics of falls after PBT.

Methods

Study Design

This study involved a prospective cohort study with comparison to a matched HIS. In 2013, physiotherapists at our institution began to implement PBT as part of routine care for appropriate patients with subacute stroke. This prevented us from undertaking a randomized controlled trial (RCT), as it would not have been ethical to allocate participants to a non-PBT control group when the intervention is part of routine care. Thus, we prospectively recruited individuals who completed PBT during inpatient rehabilitation, and compared fall rates for this group to a matched HIS who did not complete PBT, but who tracked fall events post discharge within a previous observational study.[16] The study was approved by the institution's research ethics board, and participants provided written informed consent.

Participants

Individuals with subacute stroke receiving inpatient rehabilitation at the Toronto Rehabilitation Institute were invited to participate. Participants were eligible if they met the following criteria: (1) could stand independently for at least 30 seconds; (2) could walk with or without a gait aid (but without assistance of another person) for at least 10 minutes; (3) completed and tolerated a reactive balance control assessment[17] during inpatient rehabilitation; and (4) were discharged to their own homes. The historical cohort was recruited between October 2010 and March 2013, and the prospective cohort was recruited between September 2015 and July 2016 (Fig 1).

There were 31 individuals in the PBT group. A matched sample of participants in the HIS was selected from the 73 eligible individuals in the historical cohort who participated in the previous study and did not complete

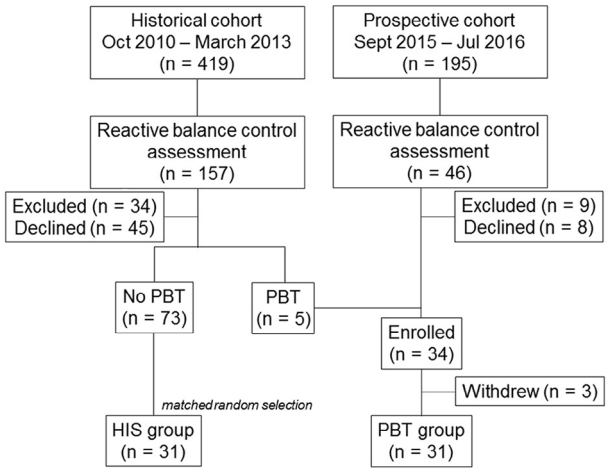

Figure 1. *Participant flowchart. Participants in the historical cohort were excluded due to insufficient English language ability (n = 11), cognitive impairment (n = 4), living too far from the hospital (n = 2), and not discharged home (n = 17); participants in the prospective cohort were excluded as they did not do PBT (n = 6), had cognitive impairment (n = 1), or were not discharged home (n = 2). Twenty-nine participants were recruited from the prospective cohort, and added to 5 historical cohort participants who completed PBT to form the PBT group. Of these, 3 withdrew without completing any falls monitoring, leaving 31 PBT participants for inclusion in the final analysis. From the 73 historical cohort participants who did not complete PBT, 31 were randomly selected to be matched to the PBT participants using the procedure described in the text. Abbreviations: HIS, historical control group; PBT, perturbation-based balance training.*