Exoskeleton Robotic Gait Training in Non-traumatic Brain Injury Patients in the Acute Inpatient Rehabilitation Setting

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OBJECTIVES

To investigate the safety, feasibility, and efficacy of a lower extremity exoskeleton (Ekso GT) in a non-traumatic brain injury population during acute inpatient rehabilitation

INTRODUCTION

Acquired brain injury is defined as any injury to the brain without congenital or traumatic etiology [1]. This can include but is not limited to stroke, tumor, anoxic brain injury, aneurysm and infection. Functional mobility deficits are the most common and often the most limiting physical impairments resulting from neurological injury. Limitations in these functional domains can result in decreased independence in instrumental and standard activities of daily living, decreased physical independence, and increased length of stay within healthcare system [2].

Ekso GT from Ekso Bionics is a lower extremity exoskeleton that offers a wide variety of functionality and training modes to allow for application to a broader patient population [3]. Little evidence has investigated the clinical utility, efficacy, feasibility, and implications of the use of exoskeleton robotic locomotor training in the nontraumatic brain injury population [4]. Investigating the clinical application of exoskeleton robotic gait training will extrapolate clinical recommendations in terms of dosage and intensity for optimal clinical outcomes.

METHODS

This is a retrospective chart review study examining 16 participants suffering from non-traumatic brain injuries (8 stroke, 4 hemorrhage, 2 anoxic, 1 brain abscess, and 1 tumor) from 4/4/2017 to 3/27/2019 at Mount Sinai Hospital. The participants underwent walking rehabilitation training sessions using Ekso GT exoskeleton as part of standard of care physical therapy intervention.

We collected 1) the Ashworth scores for the knee, hip and ankle on the affected side on a sub-acute basis, 2) the Functional Independence Measures (FIM) scores at admission and discharge, and 3) the FIM scores on the sub-acute basis for individual activities including bed/chair transfer score, the toilet transfer score, bathing score, and walking score. A series of paired sample t-tests were performed on data obtained during the rehabilitation period.

RESULTS

The study included 11 males and 5 females, and the average participant age was 50.6 (SD = 15.6). The changes in Ashworth scores and FIM scores for individual activities on a sub-acute basis were found to be insignificant ($p<0.01$). The average FIM scores collected at admission was 51.2 (SD = 20.4) and the average FIM scores collected at discharge was 84.2 (SD =23.2). The change in FIM scores at admission and discharge was found to be significant and significantly higher than the national FIM average ($p<0.05$). No safety concerns were reported.

Pt#	Gender	Age	Diagnosis	Time Since Injury	LOS	# Sessions
1	F	41	Right frontotemporal Intraparenchymal hemorrhage	7	36	3
3	F	50	Right acute lacunar infarction	7	34	5
4	M	54	Right Temporal abcess	31	57	4
5	M	51	Right MCA	8	23	5
6	M	73	Left Thalamic Infarction and Adjacent Chronic Lacunar Infarction	2	14	3
8	M	22	Right Hemorrahagic CVA due to AVM Rupture	17	72	6
9	F	32	Right Subcortical Infarction	4	28	3
10	M	80	Acute right infarction paramedian pons	9	46	2
11	M	48	Left ICH with SAH	15	41	3
12	M	77	Left MCA Infarction	4	22	1
13	M	57	Left MCA aneurysm	9	20	4
14	M	46	Left pontine CVA	4	28	5
15	F	42	right MCA	11	17	1
16	F	56	Left Frontal tumor	3	21	1

Table 1. Demographic table

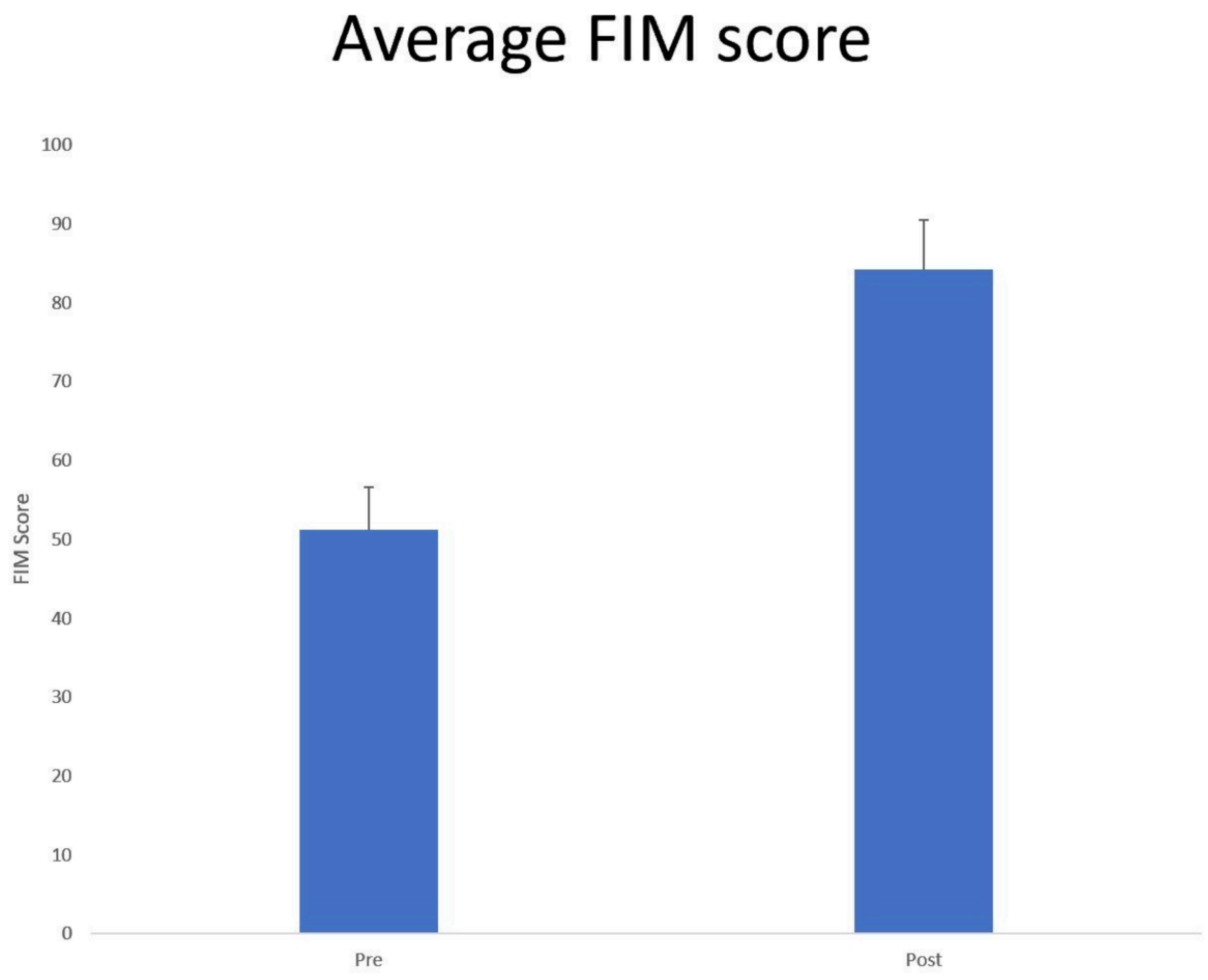

Figure 1. Average FIM Score Pre and Post Intervention

CONCLUSION/SIGNIFICANCE

Larger sample sizes a rigorous clinical trials investigating the efficacy of powered exoskeletons in non-traumatic brain injury patients in acute setting will further strengthen arguments for or against their utilization for gait rehabilitations. However, these findings suggest preliminary support of exoskeleton robotic gait training as a safe, feasible, and efficacious therapeutic intervention in an acute inpatient setting for non-traumatic brain injury patients. Further research is needed to assess which group of non-traumatic brain injuries and at which stage of rehabilitation Ekso training may be most beneficial.

Other research questions include but are not limited to:

1. How does initial functional presentation impact the nature of improvement in walking ability when using an exoskeleton device for gait rehabilitation?
2. What is the impact of different exoskeletons (number of joints actuated, level of assistance and control of stepping) on gait rehabilitation in stroke?
3. How does overground exoskeletal gait training compare to body weight-supported treadmill training?

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