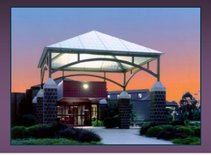

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Movement Variability During Walking and Elliptical Exercise for Individuals with Chronic Severe Traumatic Brain Injuries

Thad W. Buster, MS; Judith M. Burnfield, PT, PhD

Movement and Neurosciences Center, Madonna Rehabilitation Hospital, Lincoln, NE, USA

Movement And Neurosciences Center

Introduction

After severe traumatic brain injury (TBI), it is important to utilize movement strategies with complex variability in order to encourage recovery that is highly adaptable[1]. While elliptical machines are being used more widely in practice[2,3], it is unclear as to how their movement variability will compare to walking on a treadmill.

Purpose

- To compare movement variability of TBI participants during elliptical and walking exercise.
- We hypothesized that elliptical exercise would constrain movement variability.

Participants

Ten participants with the following qualifications:

- Initial loss of consciousness greater >6 hours
- History of severe TBI
- Currently ≥5 FIM Locomotor score
- Currently ≥6 on Rancho level of Cognitive Functioning
- Previously participated in physical therapy for walking deficits

Methods

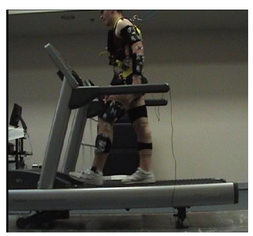
Kinematics

- Qualysis Motion Analysis System (12 Oqus infrared cameras;120 Hz)
- Foot-Floor Contact Patterns (compression-closing footswitches; 1200 Hz)

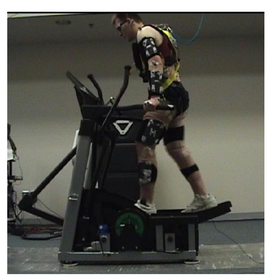
Methods

Instrumentation

Exercise equipment



Treadmill(Life Fitness, 97Ti)



Elliptical (TRUE, TSXa)

Procedures

Session 1 and 2: Familiarization

- Participants walked on treadmill and elliptical trained for 5 minutes after comfortable speed was determined

Session 1 and 2: Data Collection

- 3D lower extremity kinematic data recorded for one minute during treadmill walking and elliptical training
- Equipment order randomized

Data Analysis

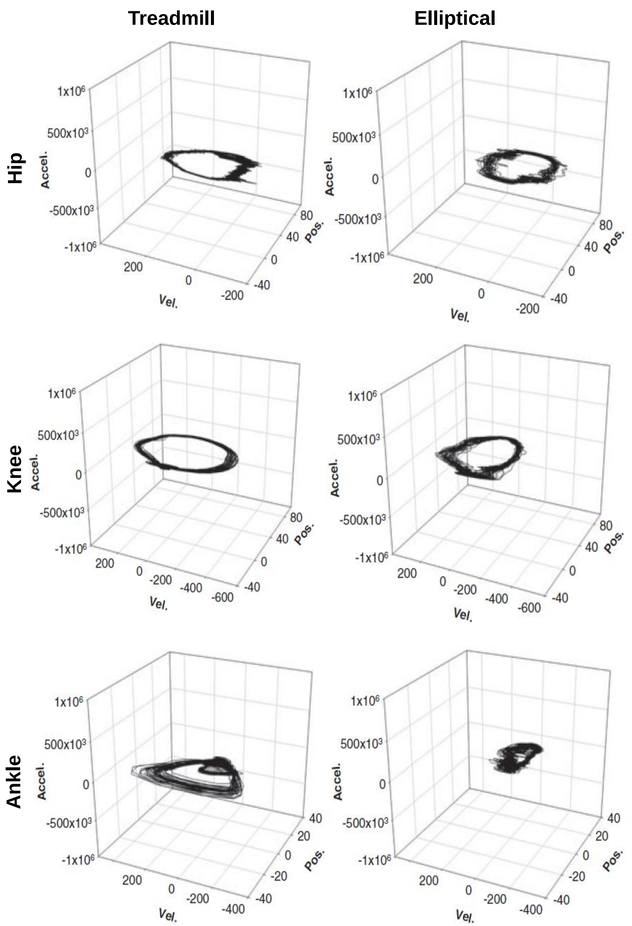
- Maximum Lyapunov exponents (LyE) calculated from 30 consecutive strides of joint motion time series at the hip, knee, and ankle for each condition.

Statistical Analysis

- Independent t-tests evaluated differences between walking and elliptical training.

Results

Three-dimensional state space plots for 30 consecutive strides. Note: less overlap indicates greater divergence (i.e. larger maximum LyE values).



Results (Cont.)

Table 1. Comparison of Hip, Knee, & Ankle Maximum LyE for Walking & Elliptical

Joint	Maximum LyE		Sig. level
	Walking	Elliptical	
Hip	0.072 (0.028)	0.067 (0.032)	P= 0.462
Knee	0.054 (0.013)	0.059 (0.009)	P= 0.332
Ankle	0.084 (0.013)	0.110 (0.030)	P= 0.024

Conclusions

Contrary to our hypothesis, elliptical exercise machines do not constrain variability. The complexity of the movement pattern variability is actually enhanced at the ankle joint. Elliptical exercise should be considered if incorporating complex variability is a rehabilitation goal.

References

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