Graded Exercise Therapy
&
Use of the Buffalo Concussion Treadmill Test

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Pathophysiology of Concussion Multifactorial and Differs between Cases

- Autonomic dysfunction / altered cerebral blood flow
- Vestibular dysfunction
- Cervical strain
- Mood disorder

Leddy et al. Regulatory and autoregulatory physiological dysfunction as a primary characteristic of post concussion syndrome: implications for treatment. NeuroRehabilitation. 2007;22(3):199–205.

Mucha et al. Vestibular dysfunction and concussion. Handb Clin Neurol. 2018;158:135-144.

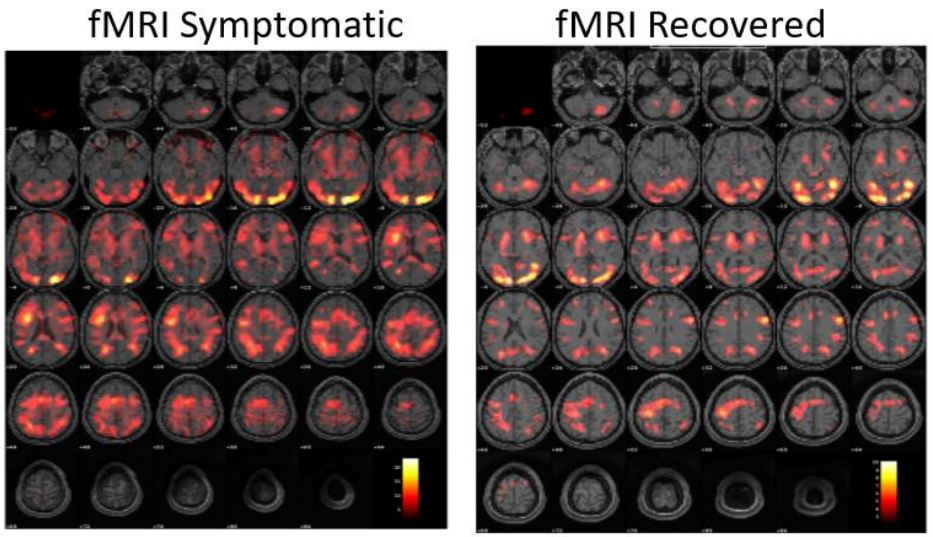
Broglio SP, Collins MW, Williams RM, Mucha A, Kontos AP. Current and emerging rehabilitation for concussion: a review of the evidence. *Clin Sports Med*. 2015;34(2):213-31.

Yrondi et al. Depression and sports-related concussion: A systematic review. Presse Med. 2017 Oct;46(10):890-902.

Autonomic dysfunction / altered cerebral blood flow

Concussion patients with ANS dysfunction demonstrate:

- Dysregulation of Cerebral blood flow
  - Decreased at rest
  - Increased during exercise
- Decreased HRV at rest
- Decreased HR during exercise
  - Difficulty achieving sufficient sympathetic state



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ORIGINAL ARTICLE

Physiological, vestibulo-ocular and cervicogenic post-concussion disorders: An evidence-based classification system with directions for treatment

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Physical exam to determine presence of ANS dysfunction:

- Exercise intolerance
- Orthostatic imbalance

*Patients who are exercise tolerant may have related condition

- Cervicogenic
- Oculomotor
- Vestibular

Graded Exercise Therapy is an Evidence Based Intervention for Concussion Patients with ANS Dysfunction

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Archives of Physical Medicine and Rehabilitation
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Archives of Physical Medicine and Rehabilitation 2019;■:■■■-■■■

ORIGINAL RESEARCH

Comparison of Rest to Aerobic Exercise and Placebo-like Treatment of Acute Sport-Related Concussion in Male and Female Adolescents

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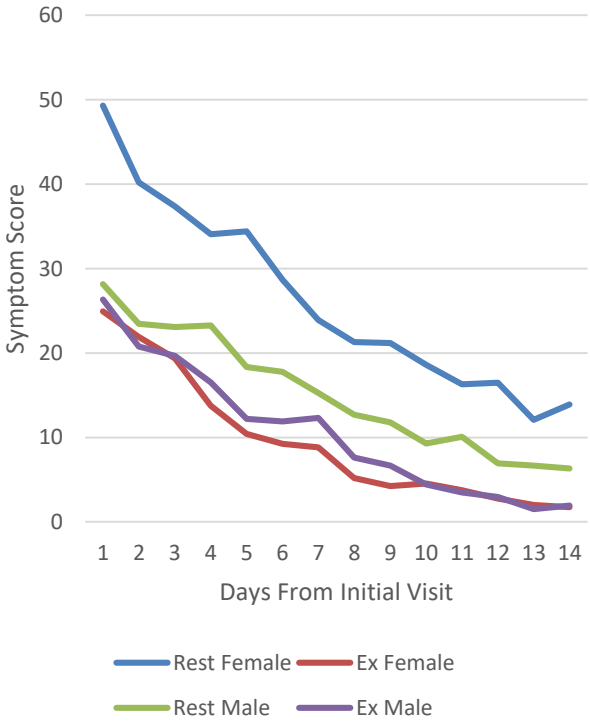
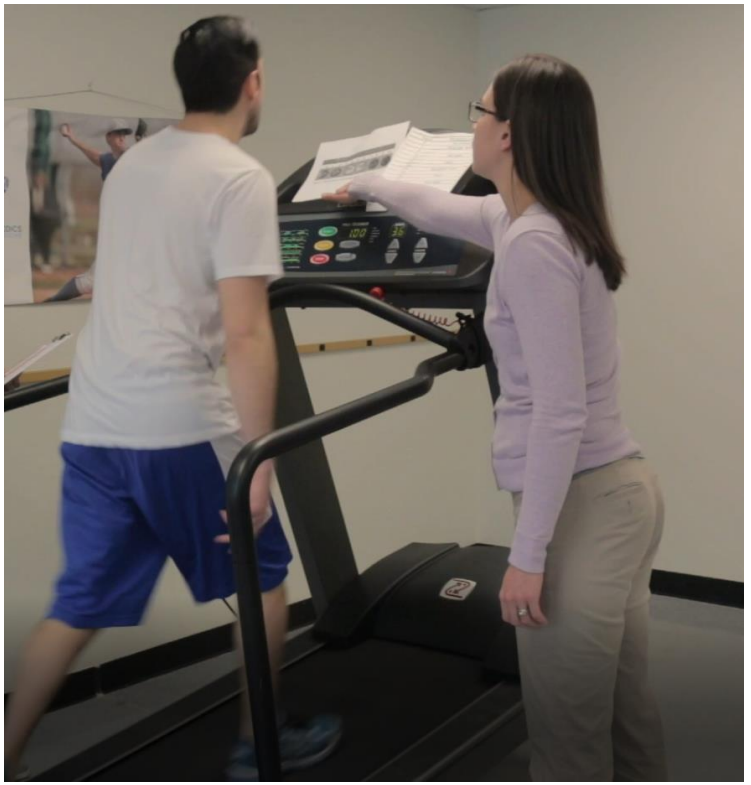


The Buffalo Concussion Treadmill Test (BCTT)

- Establish exercise intolerance
- Clarify underpinning for symptoms (differential diagnosis of post-concussion symptoms (autonomic vs. cervicogenic, vestibular, etc.)
- Identify physiologic changes associated with concussion, exacerbation of symptoms (exercise intolerance)
- Assist in treatment protocols

PLEASE CLICK TO VIEW INSTRUCTIONAL VIDEO ON THE BCTT



The BCTT

Modified Balke protocol

- Graduated exercise test
- Constant speed
- Increased incline, 1° per minute
- Measure of physical exhaustion (Borg RPE) and/or exercise intolerance

Contraindications

- Cardiovascular illness
- Respiratory dysfunction
- Beta blockers
- Serious vestibular/balance problems
- Inability to walk safely (orthopedic)
- Severe dizziness or noticeably poor balance
- Patient is too symptomatic

Table 1. Contraindications to Exercise Testing

Absolute
- Acute myocardial infarction (within 2 d)
- High-risk unstable angina*
- Uncontrolled cardiac arrhythmias causing symptoms or hemodynamic compromise
- Symptomatic severe aortic stenosis
- Uncontrolled symptomatic heart failure
- Acute pulmonary embolus or pulmonary infarction
- Acute myocarditis or pericarditis
- Acute aortic dissection

Relative†
- Left main coronary stenosis
- Moderate stenotic valvular heart disease
- Electrolyte abnormalities
- Severe arterial hypertension‡
- Tachyarrhythmias or bradyarrhythmias
- Hypertrophic cardiomyopathy and other forms of outflow tract obstruction
- Mental or physical impairment leading to inability to exercise adequately
- High-degree atrioventricular block

*ACC/AHA Guidelines for the Management of Patients With Unstable Angina/Non-ST-Segment Elevation Myocardial Infarction (350) (see Table 17).
†Relative contraindications can be superseded if the benefits of exercise outweigh the risks.
‡In the absence of definitive evidence, the committee suggests systolic blood pressure of >200 mm Hg and/or diastolic blood pressure of >110 mm Hg. Modified from Fletcher et al.7

Preparation

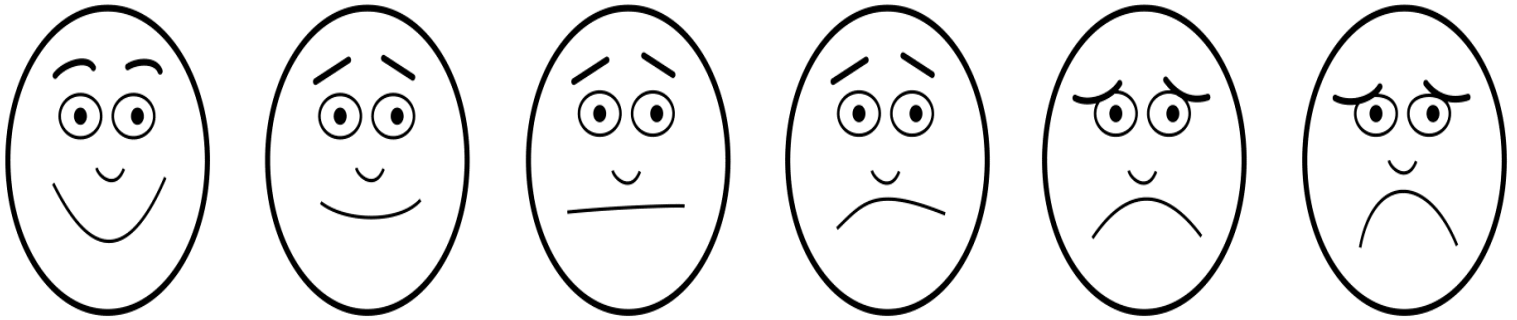
- Exercise clothing / shoes
- Chair, water, towel
- Treadmill w/ 15° (adaptable for 12°)
- Heart rate monitor
- Borg RPE scale & 10 point Likert scale
- Record sheet

Borg's Rating of Perceived Exertion (RPE) Scale

Perceived Exertion Rating	Description of Exertion
6	No exertion. Sitting & resting
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

http://monroe.uwex.edu/2015/07/21/physical-activity-benefits-consequences-and-recommendations/

Rate Your Overall Condition

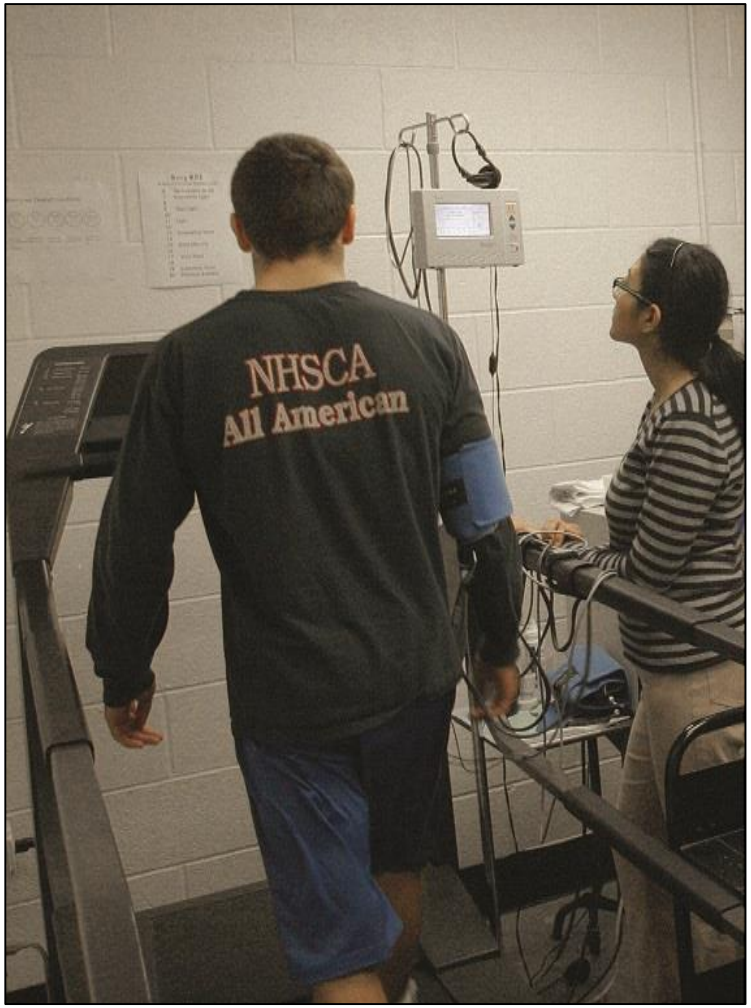


0	1-2	3-4	5-6	7-8	9-10
Feel terrific, no symptoms	Feel some symptoms but quite tolerable	Symptoms a little worse	Symptoms much worse	Feeling quite symptomatic	Feel terrible, worst I ever felt

ex. Headache, Dizziness, Light/Sound Sensitivity, Feeling “Not Right”, Difficulty Concentrating

Participant ID: _____

Min	HR	RPE	Overall condition (Likert scale)	Symptoms / Observations
REST				
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
Post-Exercise				
1				
2				



Protocol

Starting speed: brisk walk (approx. 3.3 mph)

Increase incline 1° per minute

Record HR, RPE and symptoms until:

- Participant reaches max HR or RPE of 19 (exhaustion)

OR

- Symptoms increase by ≥ 3 points (new symptom or increased symptom load) on the Likert scale (symptom exacerbation)

Protocol

- 2 minute cool down at 2.5mph, 0 incline
- Report symptoms & HR at full stop

Safety

- 2nd evaluator present
- Assess patient risk throughout (severe, sudden onset of symptoms, balance concerns)
- Engage in conversation
- Be aware of postural changes

Emphasize goal to **report** symptoms, not push through them

Outcomes

- Evaluation of symptom load, exercise intolerance
- Differential diagnosis (cervicogenic, physiologic PCS, etc.)
- Determination of safe exercise threshold (HR)

Establishing an exercise program

- For general patients 80% (90%) of HRt, 20 minutes per day after a five minute warm up
- For athletes 90% of HRt, 20 minutes per day, and if well tolerated, move to 2x per day
- Never exercise if not feeling well, and stop exercising if symptoms become exacerbated.

- 10% below threshold
- 20 minutes a day
- Don’t exercise on “bad” days
- Stop if you feel symptoms

Exercise Script Must Be Individualized and Must Be Sub-Threshold

Follow up

- After one week, increase exercise HR goal by 5%-10%.
- No need to re-examine
- May re-examine after two weeks on BCTT
- Regular communication is key