BUFFALO CONCUSSION MARCH TEST (BCMT) – INSTRUCTION MANUAL

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Purpose

- To assess the degree of exercise tolerance in patients with concussion.
- To identify the heart rate (HR) at which concussion-specific symptom exacerbation occurs (i.e. the Heart Rate Threshold [HRt]).
- To help establish a safe level of exercise for treatment of concussion.
- To help differentiate between concussion and other possible diagnoses for concussive symptoms (e.g. cervicogenic post-traumatic disorder).
- To identify physiological variables associated with exacerbation of symptoms, and the patient's level of recovery.

Caution

- **The BCMT alone should never been used to make a diagnosis of concussion or clearance to begin the return-to-play protocol. The BCMT is a supplementary test and should be interpreted alongside a complete history and physical examination.**

Eligibility

- The BCMT is designed for patients who do not have access to a treadmill or bike.
- Do not perform the BCMT if the patient is experiencing such cervical dysfunction that motion while walking and/or marching could cause considerable pain or harm, is experiencing vestibular/balance issues that would impair the ability to safely complete the proper protocol, or has a lower extremity or spinal orthopedic injury that compromises safe walking.
- Before beginning the BCMT, participants should be evaluated for any contraindications to exercise testing. The AHA Guidelines contraindications to exercise testing are as follows:

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

  Relative Contraindications
  - Left main coronary stenosis
  - Moderate stenotic valvular heart disease
  - Electrolyte imbalance
  - Severe arterial hypertension (>200 mmHg systolic or >110 mmHg diastolic)
  - Tachyarrhythmia or bradyarrhythmia
  - Hypertrophic cardiomyopathy and other forms of outflow tract obstruction
  - Mental or physical impairment leading to inability to exercise adequately
  - High-degree atrioventricular block

- The BCMT is not recommended within 24 hours of concussive brain injury or if the patient is too symptomatic (symptom severity 7/10 or more).

Safety Considerations

- While testing, participants must be dressed for exercise (comfortable clothing, running shoes), wearing any vision or hearing aids (glasses, etc.), and should be hydrated.
- It is suggested that at least 1 person trained in CPR be present at the time the test is being performed
- It is suggested that 2 persons assist in conducting the BCMT in order to assure safety of the participant, with 1 examiner positioned beside the patient at all times while test is in progress.
- It is important to engage in casual conversation with the patient during the exercise test to assess his/her confidence level as well as any changes in cognitive and communicative functioning. As exercise intensifies, note if patient seems to have difficulty communicating, looks suddenly pale or withdrawn, or otherwise appears to be masking serious discomfort.
- Be aware of postural and structural changes (slouching, rounding the back, leaning head) since noting the patient's thoracic and cervical posture can offer clues on the etiology of the injury.

Equipment Requirements

- Tape
- BCMT metronome click track file on computer or smart phone
- HR monitor (Polar arm band or chest band is recommended)
- BCMT Assessment Form for monitoring HR, symptom severity, RPE and relevant observations – *See form attached*
- Visual Analogue Scale (VAS): Can be explained to patients as a measure of "how bad their concussion-specific symptoms are". It should be clarified that getting tired from walking on a treadmill is not a concussion-specific symptom and should be reported in the next scale - *See form attached*
- Borg Rating of Perceived Exertion (RPE): Can be explained to patients as a measure of "how hard you feel like you're working out". The scale ranges from 6 – 20, 6 being no exertion and 20 being the maximum they can ever do. Descriptors of each exercise intensity level should be pointed out and patient should be allowed to read through it before the test begins. - *See form attached*
- Chair, water and towel for patient recovery after exercise.

Setup

- Attach HR monitoring device according to manufacturer's instructions.
- Place RPE and VAS scales within comfortable viewing distance of participant while completing the test (it is suggested that participants should not have to turn head to view scales).
- Adhere tape to wall indicating the position of the midpoint of the participant's thigh at 45 degrees of hip flexion to serve as a guide for proper hip flexure.

Test Protocol

1) Inform patient about test procedures and what to expect during the BCMT. The duration of the March Test is 15 minutes. Starting tempo is 70 bpm and increases 10 bpm each minute. Throughout the test, the patient is to maintain upright posture. The tape should be placed on an adjacent wall at half the height of the greater trochanter (45 degrees of help flexion). Patients are to raise one knee and then the other according to each beat of the metronome track to the height of the tape on the wall.
2) Explain and demonstrate the VAS and RPE scales and obtain resting scores. Remind the patient that he/she will be asked to rate symptom severity and exertion each minute during exercise.
3) Obtain resting HR after 2-minute seated position before guiding the patient to the previously taped wall.
4) The patient should begin by standing parallel to the wall with the tape clearly visible beside them. The examiner should provide a brief countdown prior to starting the track. The HR at Stage 0 is the HR when the patient immediately begins the BCMT and not during the 2-minute seated rest.
5) After 1 minute at the beginning pace, the tempo will increase 10 bpm. Approximately 5 seconds before the conclusion of each 1-minute stage, ask the patient to rate their symptom severity and perceived level of

exertion. Examiner should record heart rate and general observations as the test progresses, if needed. This procedure is repeated each minute of the BCMT.
Changes to VAS rating should be specifically clarified/noted. For example, if the rating moves from 2 to 3, it should be clarified if this reflects the addition of a new symptom and/or increased severity of an existing symptom. 1-point is given for any worsening of a symptom and 1-point for the addition of a new symptom. For example, if the patient reports symptom severity change from 2/10 to 3/10 and reports slight increase of headache and onset of light sensitivity, then this should be considered a 2-point increase to 4/10.

6) Once the test is terminated (see Stopping Criteria below), instruct the participant to sit. HR, RPE, VAS plus any additional comments (if needed) are recorded after the 2-minute recovery.
7) Patient is allowed to rest on a chair in a quiet environment until symptom severity returns to pre-BCMT value or patient feels like they are able to continue with remainder of the clinical visit.

Stopping Criteria

The BCMT is terminated based on the following criteria:

1) Patient can no longer maintain marching protocol; defined as inability to raise knees to at least the level of the taped line at the pace indicated by the metronome for a consecutive 10 seconds.
2) Test completion.
3) Symptom exacerbation - defined as an increase of 3 or more points on the VAS scale from resting VAS score.
4) Voluntary exhaustion – defined as an RPE of > 17 without significant symptom exacerbation. If the patient has not reached at least 80% of age predicted maximum (calculated as 220 – age), the examiner should encourage the patient to try and keep going but should not push the patient if they are too exhausted.
5) Examiner notes a rapid progression of complaints (pressure in head to searing focal headache) or patient appears faint or has stopped communicating or continuing the test constitutes a significant health risk for the patient.
6) Patient has reached 90% or more of age predicted maximum without any increase in symptoms and still reporting low RPE. The RPE scale should be discussed with the patient at this time to make sure they accurately understand it before we begin the cool down period.
7) Patient requests to stop for any reason. The reason for stopping, other than the above mentioned, should be recorded in the BCST Assessment Form.

Interpretation

- The maximum HR achieved on the BCMT at symptom exacerbation is called the Heart Rate threshold (HRt) and a safe level of exercise is considered to be below 90% of HRt.
- If the patient is able to exercise to voluntary exhaustion without any increase in symptoms (i.e. does not have symptom-limited exercise intolerance) but is not cleared to return-to-play because of symptoms at rest or physical examination impairments, then the patient can perform aerobic exercise at any HR up to the maximum achieved or at 85% of age appropriate maximum.
- Patients who have symptoms at rest, but do not have a physiologic threshold (can exercise to max without increase in concussion-specific symptoms) should be evaluated for dysfunction of the cervical spine, vestibular system or temporomandibular region.

Buffalo Concussion March Test Assessment Form

Patient: _____ Date: _____

Min	Metronome Tempo (BPM)	HR	RPE	VAS scale	Symptom reports	Observations
REST			NA			
0	**70**					
1						
2	**80**					
3	**90**					
4	**100**					
5	**110**					
6	**120**					
7	**130**					
8	**140**					
9	**150**					
10	**160**					
11	**170**					
12	**180**					
13	**190**					
14	**200**					
15	**210**					
Post (2 min)						

Maximum Heart Rate at Symptom Exacerbation: _____/ NA Tester: _____

Additional comments: _____

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Borg Rating of Perceived Exertion

Rating of Perceived Exertion / The Borg Scale		
Green	6	Zero exertion
	7	Extremely light
	8	Minimal recognition of effort
Yellow	9	Very light exertion (Comfortable walking pace)
	10	Can just start to hear your breathing
	11	Conversation is easy and you can run like this for a while
	12	Light exertion
Orange	13	Somewhat hard
	14	You can hear your breathing but you're not struggling
	15	You can talk but not in full sentences
	16	Hard work
Red	17	Very hard – Starting to get uncomfortable
	18	You can no longer talk because of your breathing
	19	Extremely hard – Your body is screaming at you
	20	Maximal exertion

Visual Analogue Scale