

BUFFALO CONCUSSION BIKE TEST (BCBT) – 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 BCBT alone should never be used to make a diagnosis of concussion or clearance to begin the return-to-play protocol. The BCBT is a supplementary test and should be interpreted alongside a complete history and physical examination.**

Eligibility

- The BCBT is designed for patients who have significant vestibular/balance problems which prevents them from walking safely on a treadmill.
- Before beginning the BCBT, 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 BCBT 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 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

- Recumbent or upright stationary bike capable of maintaining a constant power output or "workload" (measured in Watts) that can be controlled by the test administrator.
- HR monitor (Polar OH arm band or chest band is recommended).
- BCBT Assessment Form for monitoring HR, power output, symptom severity, RPE and relevant observations – *See form attached*
- BCBT Weight to Power/Watt Conversion Table. - *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 cycling on a cycle ergometer 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.
- Determine power out required for each stage according to patient's weight.
- Place RPE and VAS scales within comfortable viewing distance of participant while on cycle ergometer (it is suggested that participants should not have to turn head to view scales).

Test Protocol

- 1) Inform participant about test procedures and what to expect during the BCBT. Review in detail that the purpose is not to "push through" symptoms but to honestly report them.
 - 2) Explain and demonstrate the RPE and VAS and obtain resting scores. Remind participant that he/she will be asked to rate RPE and symptom severity every 2 minutes during exercise.
 - 3) Obtain resting HR after 2-minute seated position before getting the patient on cycle ergometer.
 - 4) Care should be taken to ensure the cycle ergometer settings, such as seat and handle bar heights, are appropriate to the participant. The participant should not assume a standing position at any time during the protocol.
 - 5) The HR at Stage 0 is the HR when the patient is sitting on the cycle ergometer immediately after starting the BCBT and not after the 2-minute seated rest.
 - 6) Tell the participant to start pedaling at 60 ± 5 RPM. Participant must maintain a relatively consistent pace throughout the test.
 - 7) After 2 minutes at this power output, adjust power output for Stage 1. Ask participant to rate exertion on RPE and symptom severity on VAS at the beginning of each stage. Record HR at the beginning of each stage. Examiner should also record general observations as the test progresses if needed. This procedure is repeated every 2 minutes with the power output at the subsequent stage.
- 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.

- 8) Once test is terminated (see Stopping Criteria below), power output is reduced to starting level (Stage 0) for a 2-minute cool down (if patient is able). For the cool down, the patient is asked to pedal at the slowest RPM (approximately 30 rpm). HR, RPE, VAS plus any additional comments (if needed) are recorded after the 2-minute cool down.
- 9) Patient is allowed to rest on a chair in a quiet environment until symptom severity returns to pre-BCBT value or patient feels like they are able to continue with remainder of the clinical visit.

Stopping Criteria

The BCBT is terminated based on the following criteria:

- 1) Symptom exacerbation - defined as an increase of 3 or more points on the VAS scale from resting VAS score.
- 2) 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.
- 3) 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.
- 4) 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.
- 5) Patient requests to stop for any reason. The reason for stopping, other than the above mentioned, should be recorded in the BCBT Assessment Form.

Interpretation

- The maximum HR achieved on the BCBT 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.

For more information, please visit concussion.ubmd.com

Buffalo Concussion Bike Test Assessment Form

Patient: _____

Date: _____

Weight: _____ kg

Stage	Minute	HR	RPE	VAS scale	Symptom reports	Observations
REST	REST		NA			
0	0					
1	2					
2	4					
3	6					
4	8					
5	10					
6	12					
7	14					
8	16					
9	18					
10	20					
11	22					
12	24					
13	26					
14	28					
15	30					
16	32					
17	34					
18	36					
19	38					
20	40					
Post (2 min)	Post (2 min)					

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

Additional comments: _____

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 (VAS)

Rate Your Overall Condition

Choose a number from 0 to 10 and describe your condition.



0

Feel Terrific
No Symptoms



2

Feel some
symptoms but
quite tolerable



4

Symptoms a
little worse



6

Symptoms
worse



8

Symptoms
much worse



10

Feel Terrible
Worst I ever felt

BE SURE TO TELL YOUR DOCTOR THE CONDITION YOU ARE IN

BCBT Weight (in KG) to Power/Watt Conversion Table

		Weight in KG																	
Stage	Min	35.0	37.5	40.0	42.5	45.0	47.5	50.0	52.5	55.0	57.5	60.0	62.5	65.0	67.5	70.0	72.5	75.0	77.5
0	0	18	19	20	21	23	24	25	26	28	29	30	31	33	34	35	36	38	39
1	2	22	24	26	27	29	30	32	34	35	37	39	40	42	43	45	47	48	50
2	4	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61
3	6	32	35	37	39	42	44	46	49	51	53	55	58	60	62	65	67	69	72
4	8	37	40	43	45	48	51	53	56	59	61	64	67	69	72	75	77	80	83
5	10	42	45	48	51	54	57	60	63	66	69	73	76	79	82	85	88	91	94
6	12	47	51	54	57	61	64	68	71	74	78	81	84	88	91	95	98	101	105
7	14	52	56	60	63	67	71	75	78	82	86	90	93	97	101	104	108	112	116
8	16	57	61	65	69	74	78	82	86	90	94	98	102	106	110	114	118	123	127
9	18	62	67	71	76	80	84	89	93	98	102	107	111	116	120	124	129	133	138
10	20	67	72	77	81	86	91	96	101	105	110	115	120	125	129	134	139	144	149
11	22	72	77	82	88	93	98	103	108	113	118	124	129	134	139	144	149	154	160
12	24	77	83	88	94	99	105	110	116	121	127	132	138	143	149	154	160	165	171
13	26	82	88	94	100	105	111	117	123	129	135	141	146	152	158	164	170	176	181
14	28	89	95	101	108	114	120	127	133	139	146	152	158	165	171	177	184	190	196
15	30	92	98	105	112	118	125	131	138	144	151	158	164	171	177	184	190	197	204

		Weight in KG																	
Stage	Min	80.0	82.5	85.0	87.5	90.0	92.5	95.0	97.5	100.0	102.5	105.0	107.5	110.0	112.5	115.0	117.5	120.0	
0	0	40	41	43	44	45	46	48	49	50	51	53	54	55	56	58	59	60	
1	2	51	53	55	56	58	59	61	63	64	66	67	69	71	72	74	75	77	
2	4	63	65	67	69	71	73	74	76	78	80	82	84	86	88	90	92	94	
3	6	74	76	79	81	83	86	88	90	92	95	97	99	102	104	106	109	111	
4	8	85	88	91	93	96	99	101	104	107	109	112	115	117	120	123	125	128	
5	10	97	100	103	106	109	112	115	118	121	124	127	130	133	136	139	142	145	
6	12	108	111	115	118	122	125	128	132	135	138	142	145	149	152	155	159	162	
7	14	119	123	127	131	134	138	142	146	149	153	157	160	164	168	172	175	179	
8	16	131	135	139	143	147	151	155	159	163	167	172	176	180	184	188	192	196	
9	18	142	147	151	155	160	164	169	173	178	182	187	191	195	200	204	209	213	
10	20	153	158	163	168	173	177	182	187	192	197	201	206	211	216	220	225	230	
11	22	165	170	175	180	185	191	196	201	206	211	216	221	227	232	237	242	247	
12	24	176	182	187	193	198	204	209	215	220	226	231	237	242	248	253	259	264	
13	26	187	193	199	205	211	217	222	228	234	240	246	252	258	263	269	275	281	
14	28	203	209	216	222	228	235	241	247	254	260	266	273	279	285	292	298	304	
15	30	210	217	223	230	236	243	250	256	263	269	276	282	289	295	302	309	315	

