CLINICAL PERSPECTIVES IN CONCUSSION MANAGEMENT

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37
64
77
84
28


52
Dave Duerson
DAVE
MIRRA
1974–2016

IMMEDIATE SIGNS

- THESE SIGNS ARE OFTEN ABSENT AT TIME OF INJURY:
  - LOSS OF CONSCIOUSNESS
  - POSTURING
  - HEADSHAKING
  - CONFUSION
- REPORTING SYMPTOMS (SUCH AS HEADACHE)
  - THE MOST COMMON ENTRY PATHWAY TO CARE

Glascow Coma Scale

Step 2: Glasgow Coma Scale

Typically, GCS is assessed once. Additional scoring columns are provided for monitoring over time, if needed.

Time of Assessment:

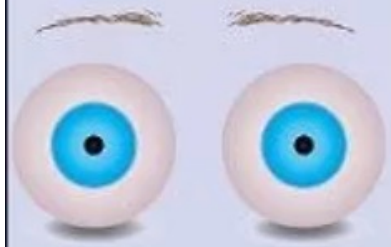
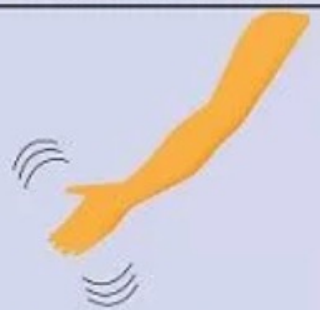
Date of Assessment:

Best Eye Response (E)			
No eye opening	1	1	1
Eye opening to pain	2	2	2
Eye opening to speech	3	3	3
Eyes opening spontaneously	4	4	4

Best Verbal Response (V)			
No verbal response	1	1	1
Incomprehensible sounds	2	2	2
Inappropriate words	3	3	3
Confused	4	4	4
Oriented	5	5	5

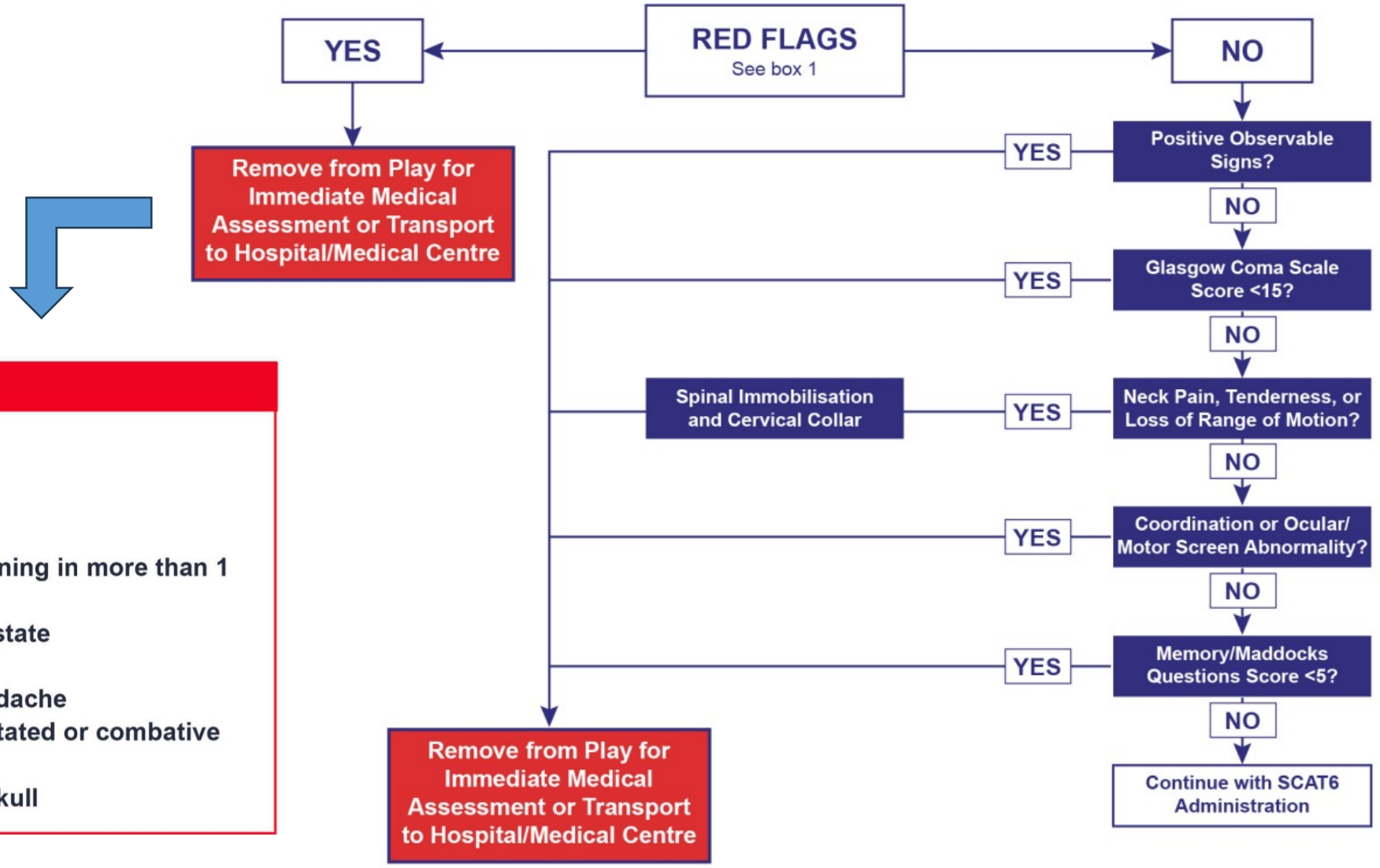
Best Motor Response (V)			
No motor response	1	1	1
Extension to pain	2	2	2
Abnormal flexion to pain	3	3	3
Flexion/withdrawal to pain	4	4	4
Localized to pain	5	5	5
Obeys commands	6	6	6

Glasgow Coma Score (E + V + M)			

Behaviour	Response
 Eye Opening Response	4. Spontaneously 3. To speech 2. To pain 1. No response
 Verbal Response	5. Oriented to time, person and place 4. Confused 3. Inappropriate words 2. Incomprehensible sounds 1. No response
 Motor Response	6. Obeys command 5. Moves to localised pain 4. Flex to withdraw from pain 3. Abnormal flexion 2. Abnormal extension 1. No response

SCAT-6

Immediate Neuro Assessment



Box 1: Red Flags

- Neck pain or tenderness
- Seizure or convulsion
- Double vision
- Loss of consciousness
- Weakness or tingling/burning in more than 1 arm or in the legs
- Deteriorating conscious state
- Vomiting
- Severe or increasing headache
- Increasingly restless, agitated or combative
- GCS <15
- Visible deformity of the skull

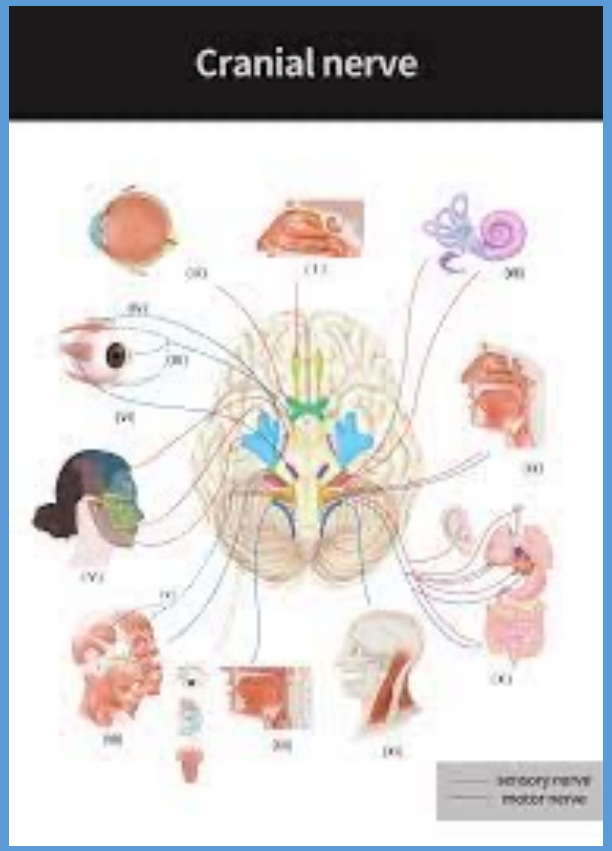
- **<u>Collaboration</u>:**
  - athletic trainers
  - physicians
  - emergency medical transport team

- Annual or Semi-Annual **PRACTICE**

- **Map** the venue for areas of access/regress

- **Team Leader must establish roles**
  - “You, call 911!”
  - “You, get the spine board/scoop stretcher”

Cranial nerve



Function	Cranial nerves	Technique
Eye assessment	II, III, IV, VI	Visual acuity, pupillary reaction, and tracking
Balance	VIII	BESS, Modified BESS, SOT
Speaking/hearing	VIII, IX, X, XII	Speaking to the patient: the patient speaking
Facial expression	V, VII, XII	Smile, frown, stick out tongue
Smelling	I	Based on self-reported symptom symptoms
Shoulder shrug	XI	Resist shoulder girdle raise



CRANIAL NERVE & QUICK NEURO SCREEN

- CERVICAL SPINE EVALUATION

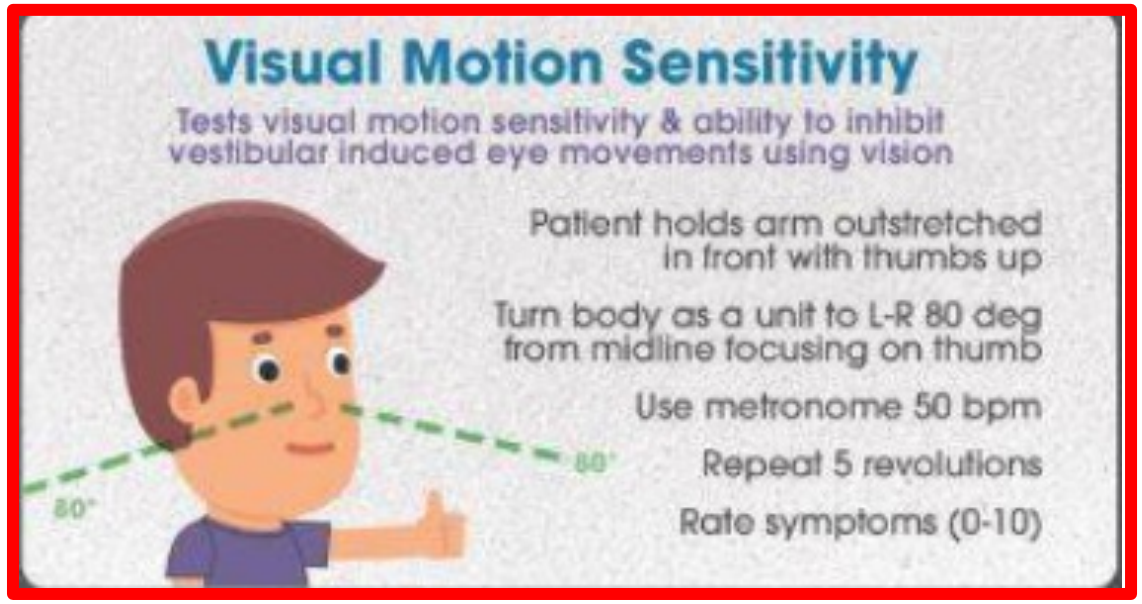

Eye Tracking

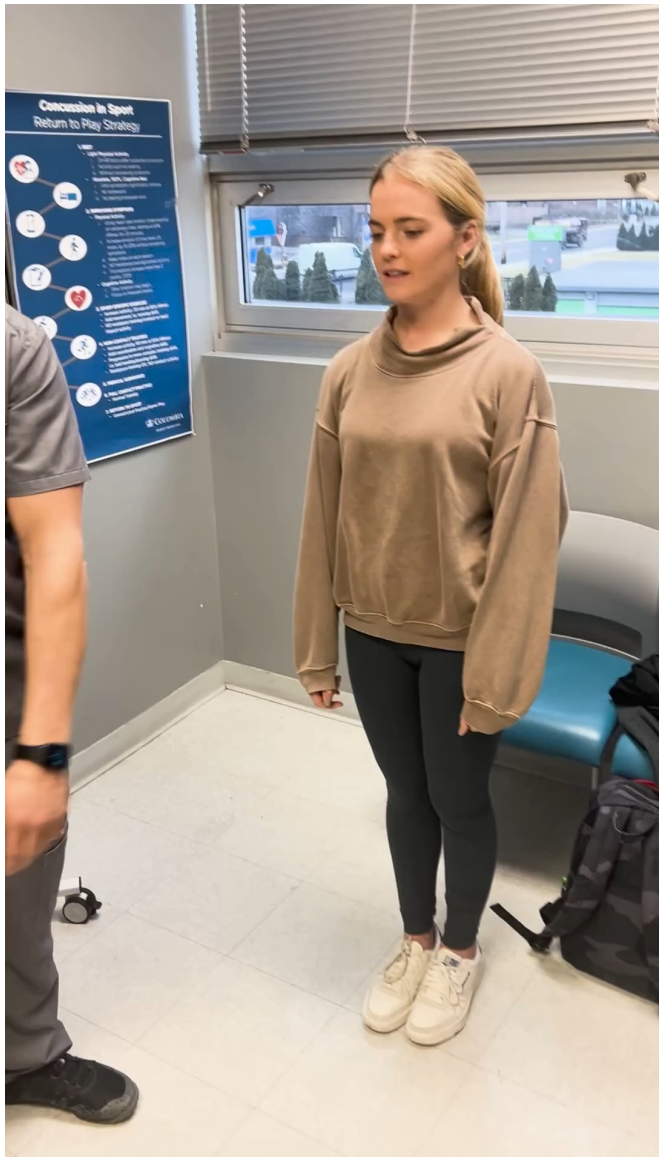

SILK
SILK


SIKSILK


SILK
SILK

VISUAL MOTION SENSITIVITY





CONVERGENCE

Modified Vestibular/Ocular-Motor Screening (mVOMS) for Concussion

For detailed instructions please see the Supplement.

mVOMS	Not Tested	Headache	Dizziness	Nausea	Fogginess	Comments
Baseline symptoms	**N/A**					
Smooth pursuits (2 horizontal and 2 vertical, 2 seconds to go full distance right-left and back; up-down and back)						
Saccades – Horizontal (10 times each direction)						
VOR – Horizontal (10 repetitions) (metronome set at 180 beats per minute – change direction at each beep, wait 10 secs to ask symptoms)						
VMS (x 5, 80° rotation side to side) (at 50 bpm, change direction each beep, wait 10 secs to ask symptoms)						

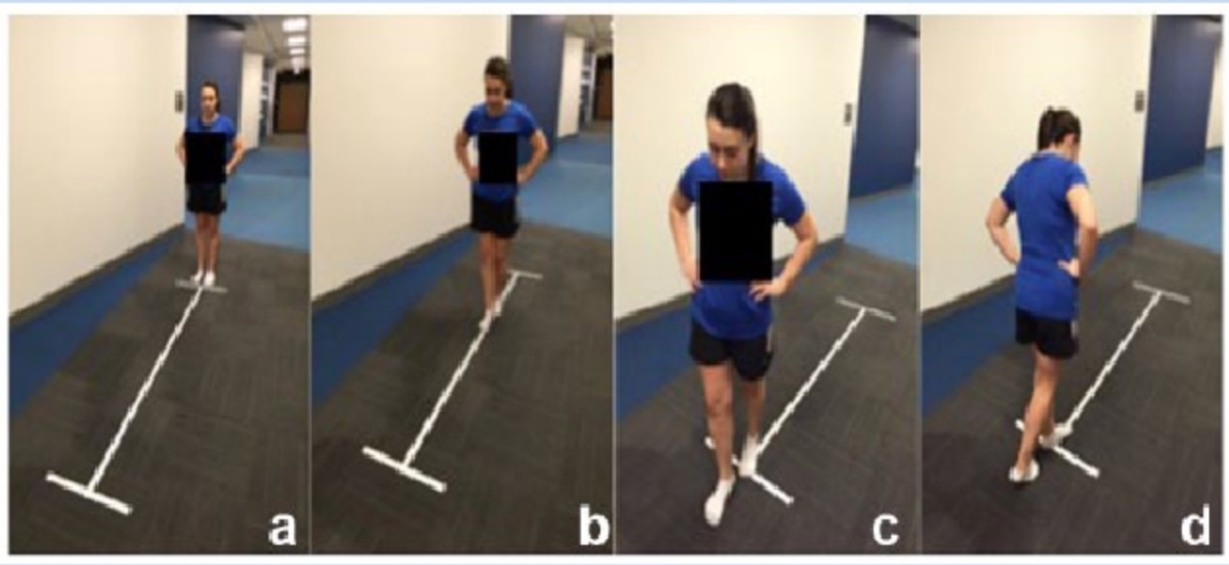
Timed Tandem Gait

Place a 3-metre-long line on the floor/firm surface with athletic tape. The task should be timed. Please complete all 3 trials.

Say ***"Please walk heel-to-toe quickly to the end of the tape, turn around and come back as fast as you can without separating your feet or stepping off the line."***

Single Task:

Time to Complete Tandem Gait Walking (seconds)				
Trial 1	**Trial 2**	**Trial 3**	**Average 3 Trials**	**Fastest Trial**



Dual Task Gait (Optional. Timed Tandem Gait must be completed first)

Place a 3-metre-long line on the floor/firm surface with athletic tape. The task should be timed.

Say ***"Now, while you are walking heel-to-toe, I will ask you to count backwards out loud by 7s. For example, if we started at 100, you would say 100, 93, 86, 79. Let's practise counting. Starting with 93, count backward by sevens until I say "stop"."*** Note that this practice only involves counting backwards.

Dual Task Practice: Circle correct responses; record number of subtraction counting errors.

Task									Errors	Time
Practice	93	86	79	72	65	58	51	44		

Say ***"Good. Now I will ask you to walk heel-to-toe and count backwards out loud at the same time. Are you ready? The number to start with is 88. Go!"***

Dual Task Cognitive Performance: Circle correct responses; record number of subtraction counting errors.

Task														Errors	Time (circle fastest)
Trial 1	88	81	74	67	60	53	46	39	32	25	18	11	4		
Trial 2	90	83	76	69	62	55	48	41	34	27	20	13	6		
Trial 3	98	91	84	77	70	63	56	49	42	35	28	21	14		

Alternate double number starting integers may be used and recorded below.

Starting Integer: **Errors:** **Time:**

Immediate Memory

All 3 trials must be administered irrespective of the number correct on Trial 1. Administer at the rate of one word per second.

Trial 1: Say *"I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order."*

Trials 2 and 3: Say *"I am going to repeat the same list. Repeat back as many words as you can remember in any order, even if you said the word before in a previous trial."*

Word list used: A ☐ B ☐ C ☐

List A	Trial 1	Trial 2	Trial 3	Alternate Lists: List B	Alternate Lists: List C
Jacket	0 1	0 1	0 1	Finger	Baby
Arrow	0 1	0 1	0 1	Penny	Monkey
Pepper	0 1	0 1	0 1	Blanket	Perfume
Cotton	0 1	0 1	0 1	Lemon	Sunset
Movie	0 1	0 1	0 1	Insect	Iron
Dollar	0 1	0 1	0 1	Candle	Elbow
Honey	0 1	0 1	0 1	Paper	Apple
Mirror	0 1	0 1	0 1	Sugar	Carpet
Saddle	0 1	0 1	0 1	Sandwich	Saddle
Anchor	0 1	0 1	0 1	Wagon	Bubble
Trial Total					

Step 3: Cognitive Screening (Continued)

Concentration

Digits Backward:

Administer at the rate of one digit per second reading DOWN the selected column. If a string is completed correctly, move on to the string with next higher number of digits; if the string is completed incorrectly, use the alternate string with the same number of digits; if this is failed again, end the test.

Say *"I'm going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7. So, if I said 9-6-8 you would say? (8-6-9)"*

Digit list used: A ☐ B ☐ C ☐

List A	List B	List C			
4-9-3	5-2-6	1-4-2	Y	N	0 1
6-2-9	4-1-5	6-5-8	Y	N	
3-8-1-4	1-7-9-5	6-8-3-1	Y	N	0 1
3-2-7-9	4-9-6-8	3-4-8-1	Y	N	
6-2-9-7-1	4-8-5-2-7	4-9-1-5-3	Y	N	0 1
1-5-2-8-6	6-1-8-4-3	6-8-2-5-1	Y	N	
7-1-8-4-6-2	8-3-1-9-6-4	3-7-6-5-1-9	Y	N	0 1
5-3-9-1-4-8	7-2-4-8-5-6	9-2-6-5-1-4	Y	N	
			Digits Score		of 4

Months in Reverse Order:

Say *"Now tell me the months of the year in reverse order as QUICKLY and as accurately as possible. Start with the last month and go backward. So, you'll say December, November... go ahead"*

Start stopwatch and CIRCLE each correct response:

December November October September August July June May April March February January

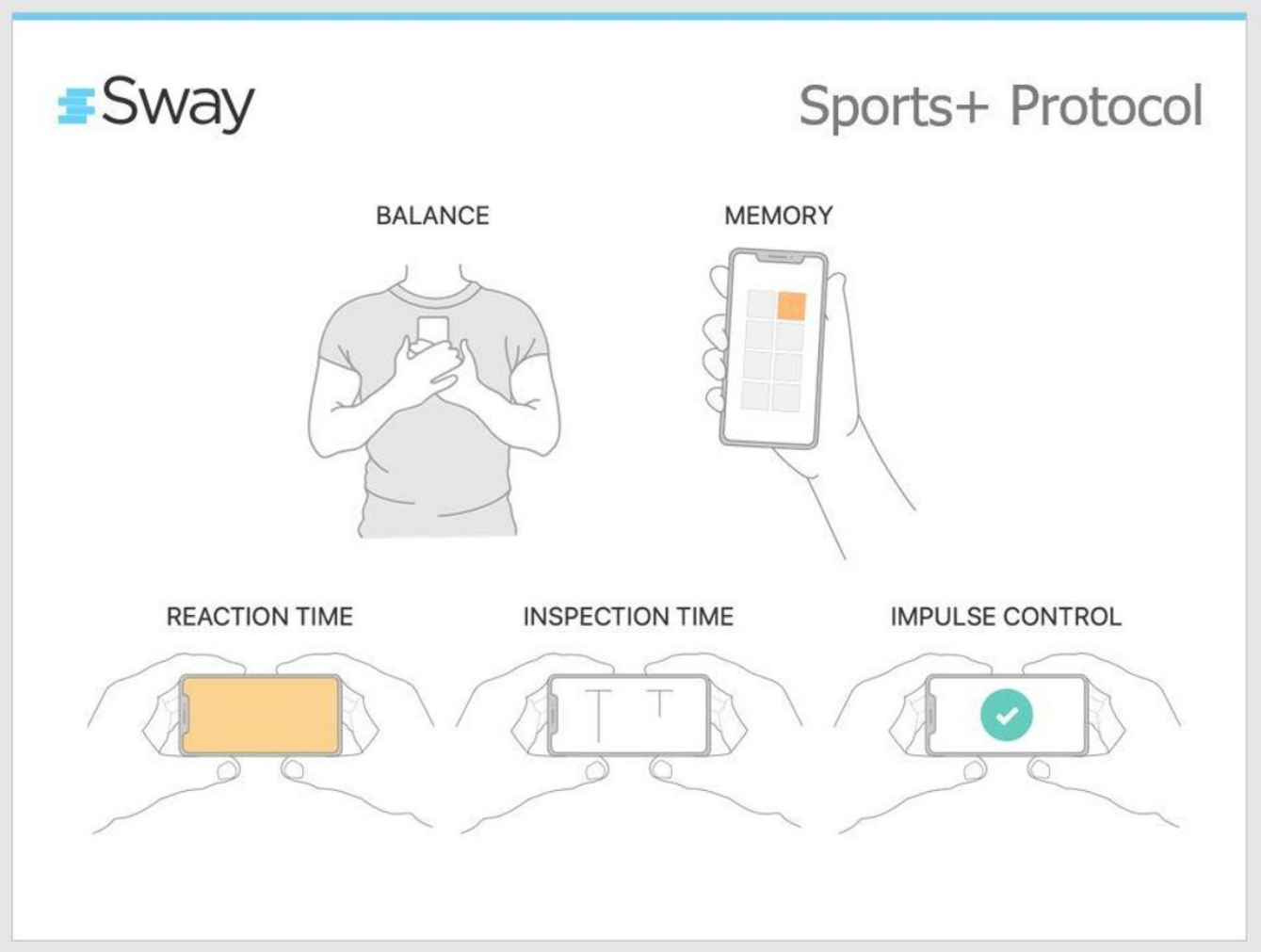
Time Taken to Complete (secs): _____ **Number of Errors:** _____

1 point if no errors and completion under 30 seconds

Months Score: _____ **of 1**

Concentration Score (Digits + Months) _____ of 5

POST EXERCISE
BALANCE
& COGNITIVE TESTING



Anxiety Screen

Not Done ☐

Assign scores of 0, 1, 2, and 3 to the response categories, respectively, of **"not at all," "several days," "more than half the days,"** and **"nearly every day."**

Over the last 2 weeks, how often have you been bothered by any of the following problems?	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious, or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it's hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3

Anxiety Screen Score: _____

0–4: minimal anxiety **5–9: mild anxiety**
10–14: moderate anxiety **15–21: severe anxiety**

Depression Screen

Not Done ☐

The purpose is to screen for depression in a "first-step" approach. Patients who screen positive should be further evaluated with the PHQ-9 to determine whether they meet criteria for a depressive disorder.

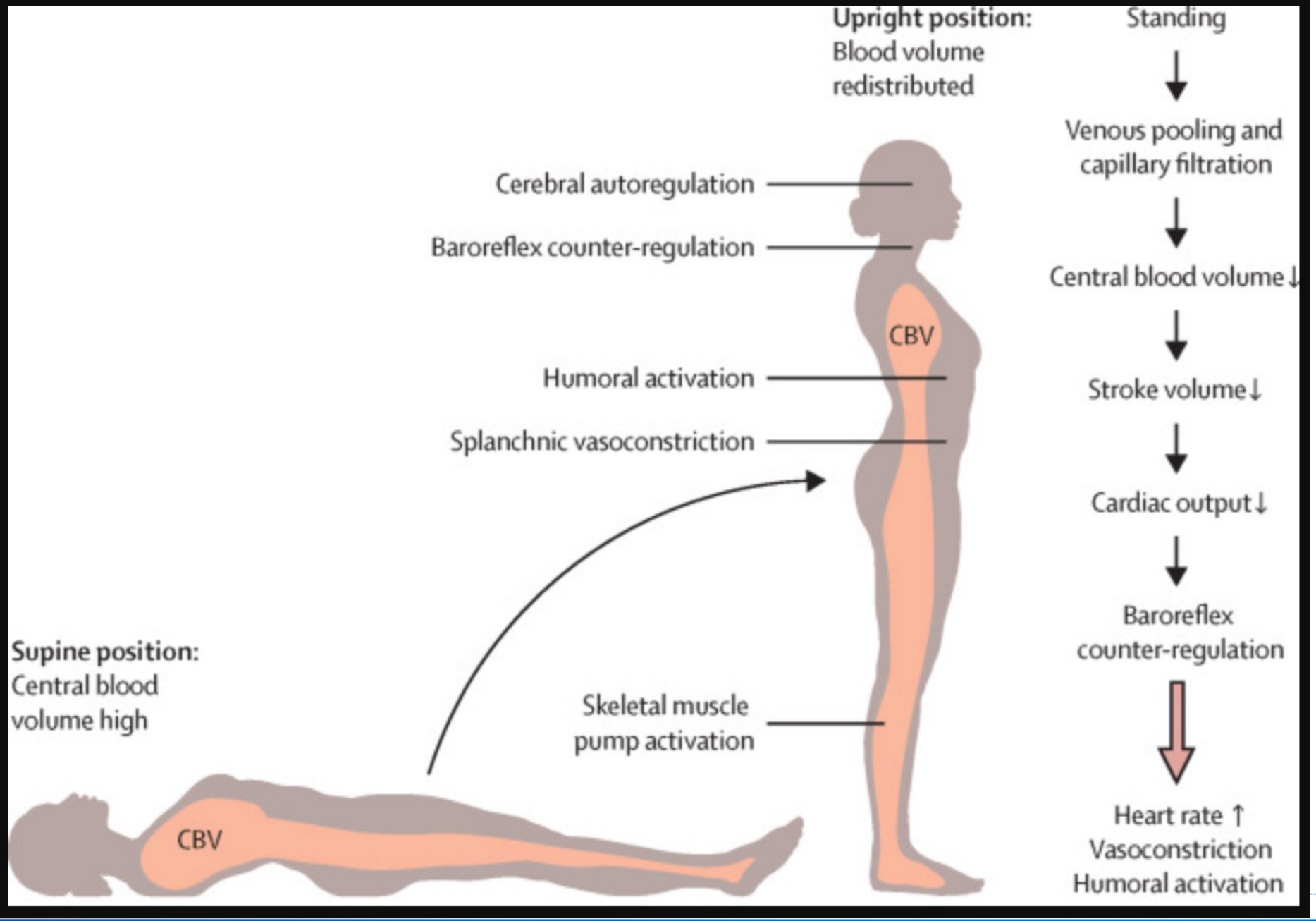
Over the last 2 weeks, how often have you been bothered by any of the following problems?	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed or hopeless	0	1	2	3

Depression Screen Score: _____ **(Ranges from 0-6, 3 being the cutpoint to screen for depression)**

SCOAT-6 ADDITIONS

* anxiety
* depression

Orthostatic Vitals



ANS

DYSREGULATION

Sport Concussion Office Assessment Tool 6 - SCOAT6™

Sleep Screen

Not Done ☐

1. During the past week how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)	
5 to 6 hours	4
6 to 7 hours	3
7 to 8 hours	2
8 to 9 hours	1
More than 9 hours	0

2. How satisfied/dissatisfied were you with the quality of your sleep?	
Very dissatisfied	4
Somewhat dissatisfied	3
Somewhat satisfied	2
Satisfied	1
Very satisfied	0

3. During the recent past, how long has it usually taken you to fall asleep each night?	
Longer than 60 minutes	3
31-60 minutes	2
16-30 minutes	1
15 minutes or less	0

4. How often do you have trouble staying asleep?	
Five to seven times a week	3
Three of four times a week	2
Once or twice a week	1
Never	0

5. During the recent past, how often have you taken medicine to help you sleep? (prescribed or over-the-counter)	
Five to seven times a week	3
Three of four times a week	2
Once or twice a week	1
Never	0

Sleep Screen Score:

A higher sleep disorder score (SDS) indicates a greater likelihood of a clinical sleep disorder:
0-4 (Normal)
5-7 (Mild)
8-10 (Moderate)
11-17 (Severe)

SLEEP

TREATMENT

- RELATIVE REST
- FREQUENT BREAKS
- EXERTIONAL PROTOCOL
- SUPPLEMENTS?
  - (VIT B2, MAGNESIUM, OMEGA-3, DHA, CO-ENZYME Q10)
- MEDS
  - NORTRYPTILINE, VERAPAMIL, DEPAKOTE, STIMULANTS, TRIPTANS, VOLTAREN GEL TOPICAL (OCCIPITAL TRIANGLE)
- PSYCH (SPORTS PSYCH)
- OCULAR
- PT (NECK, VESTIBULAR)

COGNITIVE REST IS **VITAL ~48-96** HOURS AFTER BRAIN INJURY

Return-to-Learn (RTL) Strategy

Facilitating RTL is a vital part of the recovery process for student-athletes. HCPs should work with stakeholders on education and school policies to facilitate academic support, including accommodations/learning adjustments for students with SRC when needed. Academic support should address risk factors for greater RTL duration (e.g., social determinants of health, higher symptom burden) by adjusting environmental, physical, curricular, and testing factors as needed. **Not all athletes will need a RTL strategy or academic support**. If symptom exacerbation occurs during cognitive activity or screen time, or difficulties with reading, concentration, or memory or other aspects of learning are reported, clinicians should consider implementation of a RTL strategy at the time of diagnosis and during the recovery process. When the RTL strategy is implemented, it can begin following an initial period of relative rest (Step1: 24-48 hrs), with an incremental increase in cognitive load (Steps 2 to 4). Progression through the strategy is symptom limited (i.e., no more than a mild exacerbation of current symptoms related to the current concussion) and its course may vary across individuals based on tolerance and symptom resolution. Further, while the RTL and RTS strategies can occur in parallel, student-athletes should complete full RTL before unrestricted RTS.

Step	Mental Activity	Activity at Each Step	Goal
1	Daily activities that do not result in more than a mild exacerbation* of symptoms related to the current concussion.	Typical activities during the day (e.g., reading) while minimizing screen time. Start with 5–15 min at a time and increase gradually.	Gradual return to typical activities.
2	School activities.	Homework, reading, or other cognitive activities outside of the classroom.	Increase tolerance to cognitive work.
3	Return to school part time.	Gradual introduction of schoolwork. May need to start with a partial school day or with greater access to rest breaks during the day.	Increase academic activities.
4	Return to school full time.	Gradually progress school activities until a full day can be tolerated without more than mild* symptom exacerbation.	Return to full academic activities and catch up on missed work.

NOTE: Following an initial period of relative rest (24-48 hours following injury at Step 1), athletes can begin a gradual and incremental increase in their cognitive load. Progression through the strategy for students should be slowed when there is more than a mild and brief symptom exacerbation.

*Mild and brief exacerbation of symptoms is defined as an increase of no more than 2 points on a 0-10 point scale (with 0 representing no symptoms and 10 the worst symptoms imaginable) for less than an hour when compared with the baseline value reported prior to cognitive activity.

British Journal of Sports Medicine

Phase 1: No School - Complete Cognitive Rest

- should not be attending classes, including no computer use or playing of video games, minimal use of phone, and avoiding loud music

- no assigned work in or outside of the classroom

- physical (body) and cognitive (brain) at this time is important

- no participation in extracurricular activities

Phase 2: Light Cognitive Activity Permitted

- should not attend classes, but may engage in limited activities that do not cause symptoms

- begin with 5-15 minutes of activity/studying, and may increase should symptoms not be provoked

- if symptoms develop, stop and rest

- no participation in extracurricular activities

Phase 3: Partial Classroom Attendance *with* Accommodations

- student may attend class to passively learn if nothing else

- prioritize non-elective, diploma-required classes, with one content or skill item building on another (i.e. foreign language and math)

- student allowed to participate in class, but no graded work

- minimal assigned work outside of the classroom

- classes notes should be provided

- if symptoms develop, stop and rest

- breaks as needed during class (head down or in nurse's office)

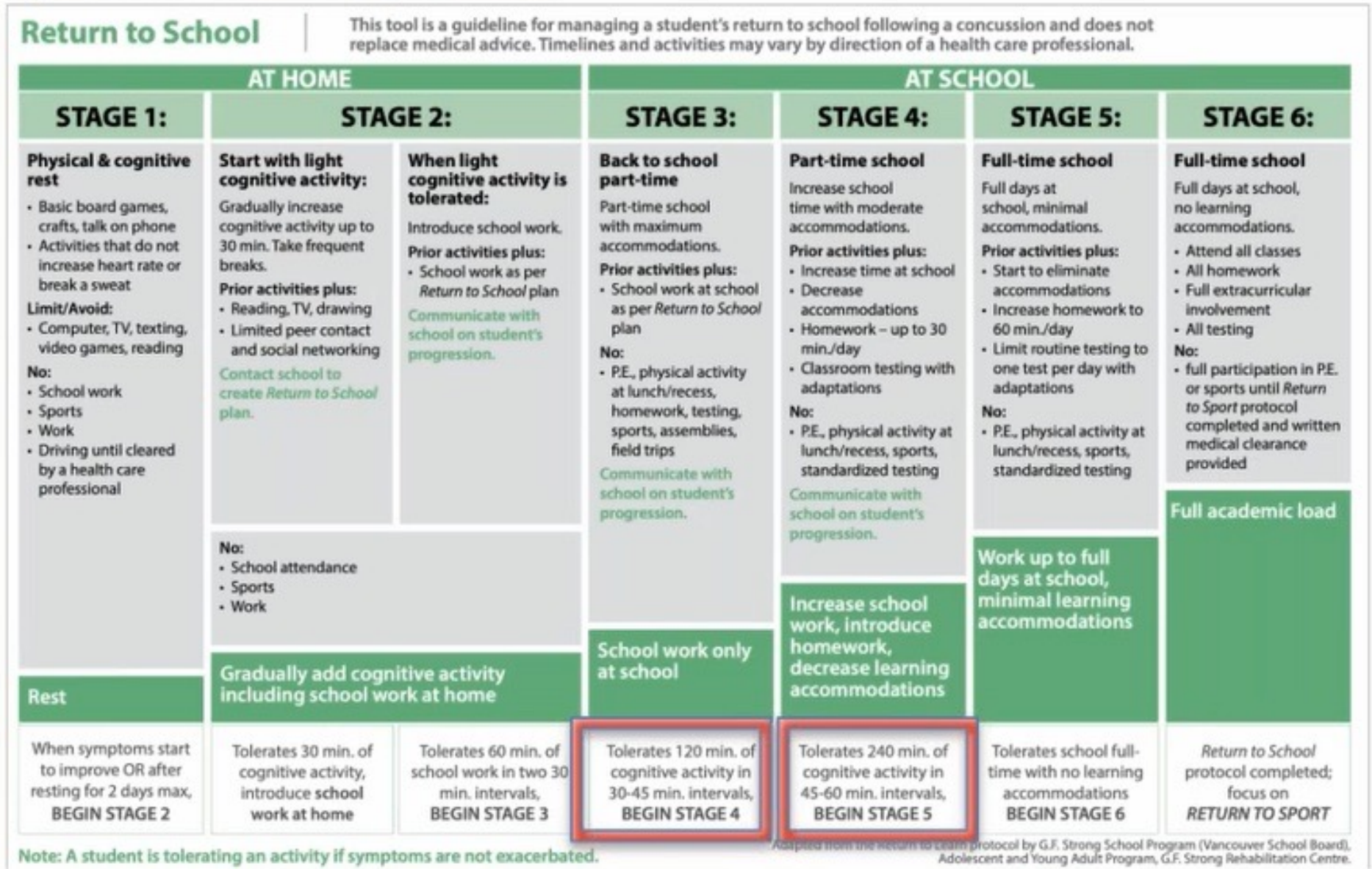
- no participation in extracurricular activities

Phase 4: Full Day Class Attendance *with* Accommodations

•- emphasis on returning to the classroom
•- classes notes should be provided
•- resumption of homework with frequent breaks
•- minimal (no more than 1 per day) in-class tests/quizzes with extra time
•- progress reports and or time lines for assignments coordinated with guidance counselor, a member of the child study team, or other designated school official should be engaged with academic progression and planning to complete missing work
•- if symptoms develop, stop and rest
•- breaks as needed during class (head down or in nurse's office)
•- no participation in extracurricular activities
•Speech to text/text to speech

•**Phase 5: Full Day Class Attendance *with Minimal* Accommodations**
•- student may resume assignments both in class and as homework
•- student may resume in class tests and quizzes
•- basic accommodations, such as breaks and extended time, may be warranted for specific subjects and should be coordinated with guidance counselor, a member of the child study team, or other designated school official
•- progress reports and or time-lines for assignments coordinated with guidance counselor, a member of the child study team, or other designated school official should be engaged with academic progression and planning to complete missing work
•**Phase 6: Full Day Class Attendance *without* Accommodations**
•- May progress and participate in academics; continue to monitor allowing for titration and self-regulation.
•- Return to learn.

Figure 1. Tool for return-to-school post-concussion



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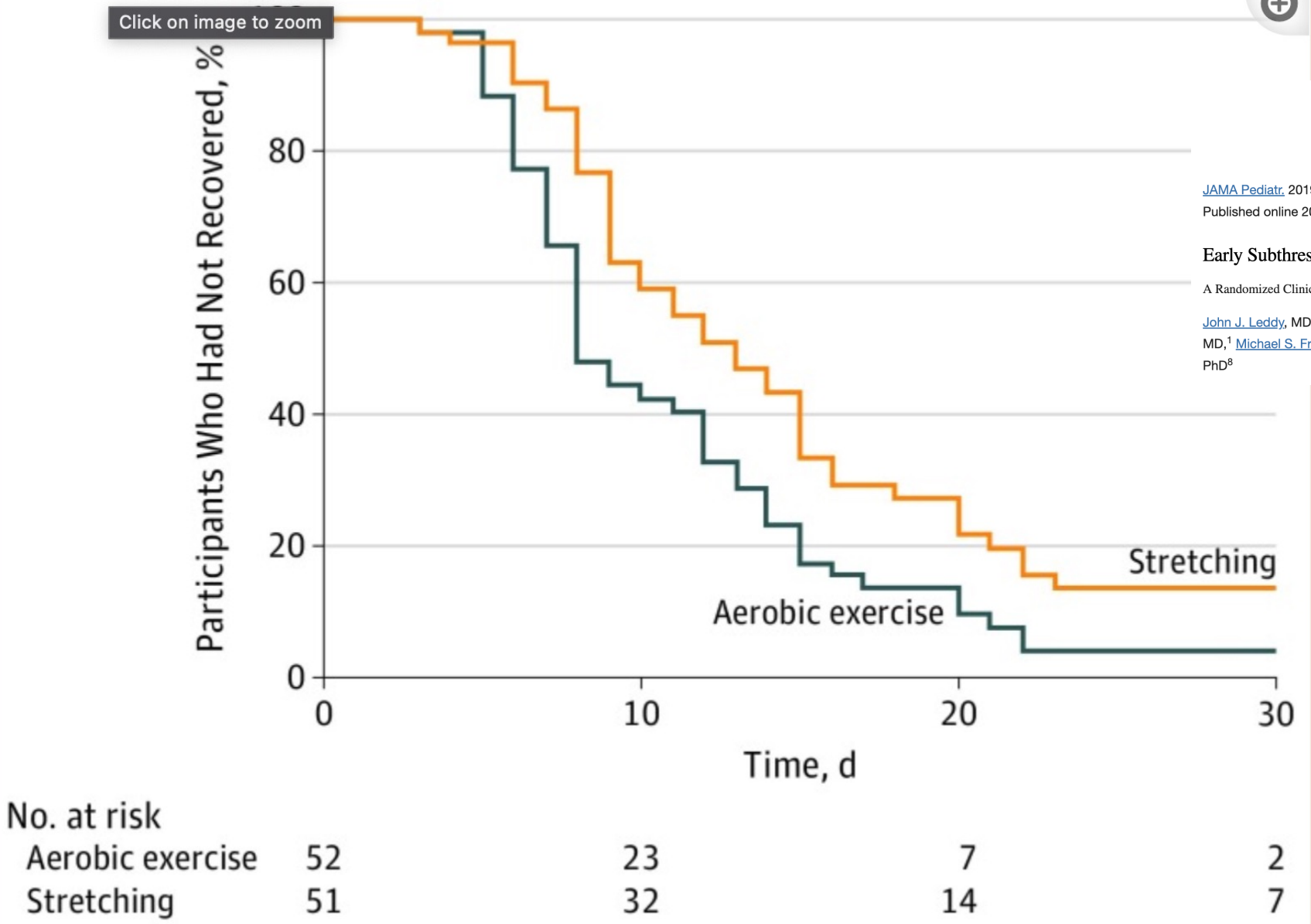

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Early Subthreshold Aerobic Exercise for Sport-Related Concussion

A Randomized Clinical Trial

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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

Using a symptom journal, progress stepwise.

Does Early Exercise in Adolescents Predict Recovery from Sports-Related Concussion?

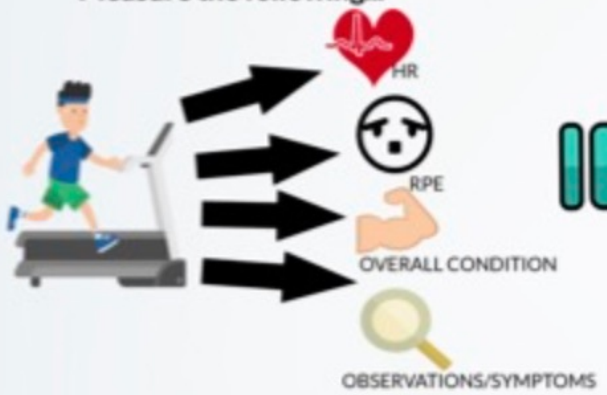
Buffalo Concussion Treadmill Test (BCTT)[1]

WHAT IS IT?
A graded exertion test for assessing exercise tolerance after concussion

WHAT IS ITS PURPOSE?
To identify the heart rate (HR) at which concussion-specific symptom exacerbation occurs (i.e. the Heart Rate Threshold [HRt])

HOW TO PERFORM THE BCTT

Measure the following...



Based on graded treadmill exercise

STAGE 0: **Patient at rest**

STAGE 1: **Incline:** 0°
Speed: 3.2mph (<5'10") or 3.6mph (>5'10")

1 minute

STAGE 2+: **Increase incline by 1°** every minute **until incline 15°**

ONCE INCLINE IS 15°: **increase speed** by **0.4mph** every minute **until 20minutes**

POST-EXERCISE: take the same measurements for **2 mins following test**

HRt- max HR during BCTT or HR at which symptoms are exacerbated

ΔHR (Heart Rate change)= HRt - HRr (HR resting)

Sub-threshold Aerobic Exercise: 20minutes/day at 80-90% HRt [1,2]

QUICKEST RECOVERY

from concussion when

Aerobic Exercise started

within 10 days

compared to

conventional rest[1,2,3]

HRt <135bpm

correlated with

prolonged recovery

time[1]

HRc <50bpm

73% sensitive &

78% specific for

delayed recovery[3]

References

1. *Clin J Sports Med.* 28(1), pp. 13-20.
2. *JAMA Pediatr.* 173(4), pp. 319-325.
3. *Front Neurol.* 10, Article 395, pp. 1-7.

AVOID COCOON

- DAILY SYMPTOM INVENTORY
- TITRATE AS TOLERATED
- COGNITIVE ACTIVITY CAN FOLLOW AND MIRROR EXERTION

Return-to-sport (RTS) strategy—each step typically takes a minimum of 24 hours

Step	Exercise strategy	Activity at each step	Goal
1	Symptom-limited activity	Daily activities that do not exacerbate symptoms (eg, walking).	Gradual reintroduction of work/school
2	Aerobic exercise **2A—Light** (up to approximately 55% maxHR) **then** **2B—Moderate** (up to approximately 70% maxHR)	Stationary cycling or walking at slow to medium pace. May start light resistance training that does not result in more than mild and brief exacerbation* of concussion symptoms.	Increase heart rate
3	Individual sport-specific exercise Note: If sport-specific training involves any risk of inadvertent head impact, medical clearance should occur prior to Step 3	Sport-specific training away from the team environment (eg, running, change of direction and/or individual training drills away from the team environment). No activities at risk of head impact.	Add movement, change of direction

Steps 4–6 should begin after the resolution of any symptoms, abnormalities in cognitive function and any other clinical findings related to the current concussion, including with and after physical exertion.

4	Non-contact training drills	Exercise to high intensity including more challenging training drills (eg, passing drills, multiplayer training) can integrate into a team environment.	Resume usual intensity of exercise, coordination and increased thinking
5	Full contact practice	Participate in normal training activities.	Restore confidence and assess functional skills by coaching staff
6	Return to sport	Normal game play.	

- ***Mild and brief exacerbation of symptoms (ie, an increase of no more than 2 points on a 0–10 point scale for less than an hour when compared with the baseline value reported prior to physical activity). Athletes may begin Step 1 (ie, symptom-limited activity) within 24 hours of injury, with progression through each subsequent step typically taking a minimum of 24 hours. If more than mild exacerbation of symptoms (ie, more than 2 points on a 0–10 scale) occurs during Steps 1–3, the athlete should stop and attempt to exercise the next day. Athletes experiencing concussion-related symptoms during Steps 4–6 should return to Step 3 to establish full resolution of symptoms with exertion before engaging in at-risk activities. Written determination of readiness to RTS should be provided by an HCP before unrestricted RTS as directed by local laws and/or sporting regulations.**
- **HCP, healthcare professional; maxHR, predicted maximal heart rate according to age (ie, 220-age).**

Psychological factors

- UNDERLYING NEUROLOGICAL & PSYCHIATRIC DIAGNOSES
- DEVELOPING SOCIAL ISOLATION IN PROLONGED SYNDROME
- ANXIETY/DEPRESSION
- ADD
- PSYCHOSOCIAL SUPPORT NEEDED IN PROLONGED AND MEDICAL RETIREMENT CASES

RTP

COMPLICATED DECISION TREE

- RISKS, BENEFITS, GOALS
- NOW VS LATER CONCERNS – FUTURE RISK WITH REPEATED EXPOSURE
- NOT THE SAME FOR CONTACT & NON-CONTACT
- BUT NO LESS COMPLICATED (I.E. BASEBALL, GYMNASTICS, SWIMMING)

GRADUATED EXERTIONAL PROGRAMMING

– SYMPTOMS INVENTORY.

Medical retirement

Neurology® Clinical Practice | American Academy of Neurology

Neurol Clin Pract. 2018 Feb; 8(1): 40–47.
doi: 10.1212/CPJ.0000000000000424

PMCID: PMC5839677
PMID: 29517059

Medical retirement from sport after concussions

A practical guide for a difficult discussion

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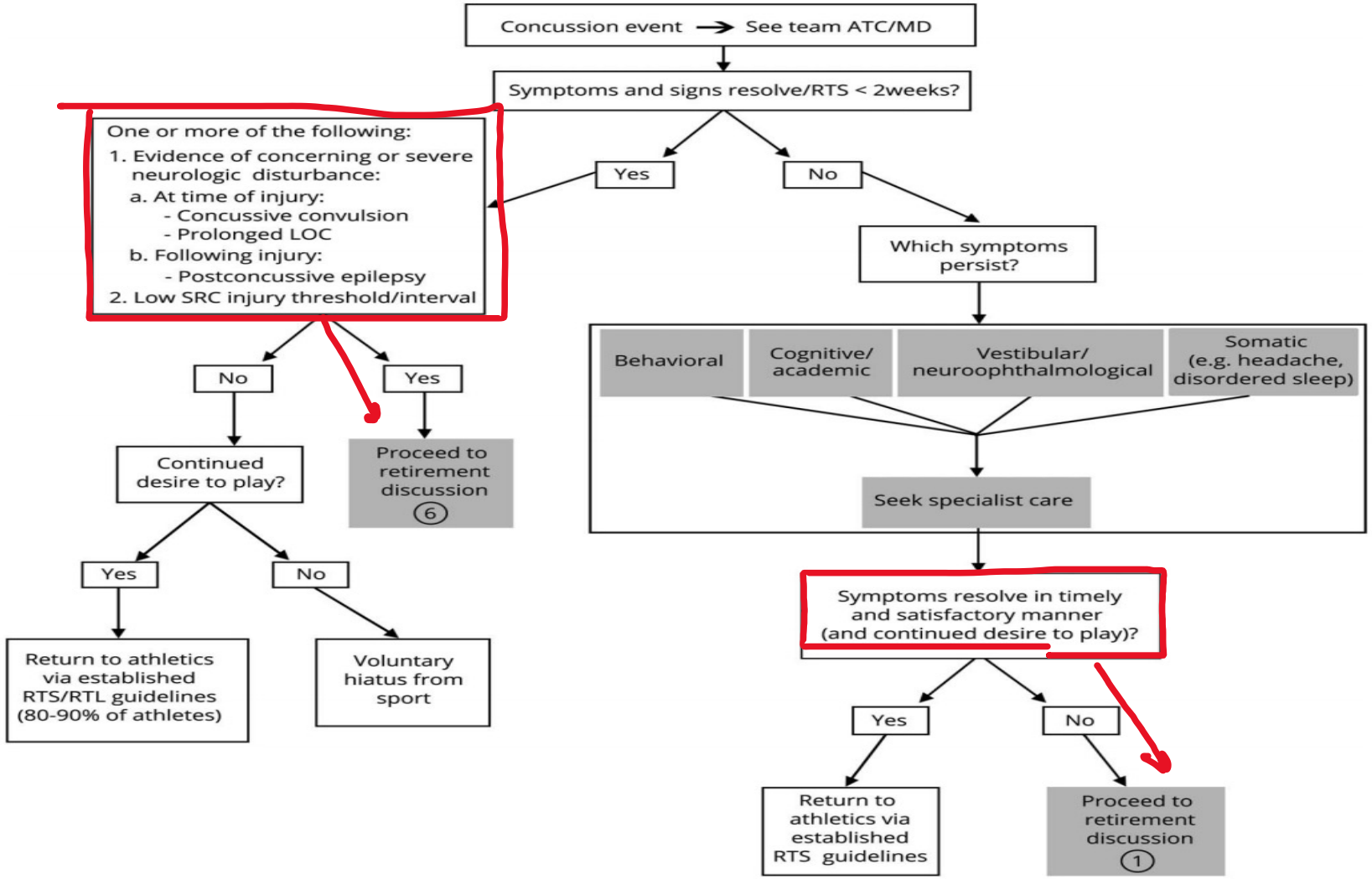
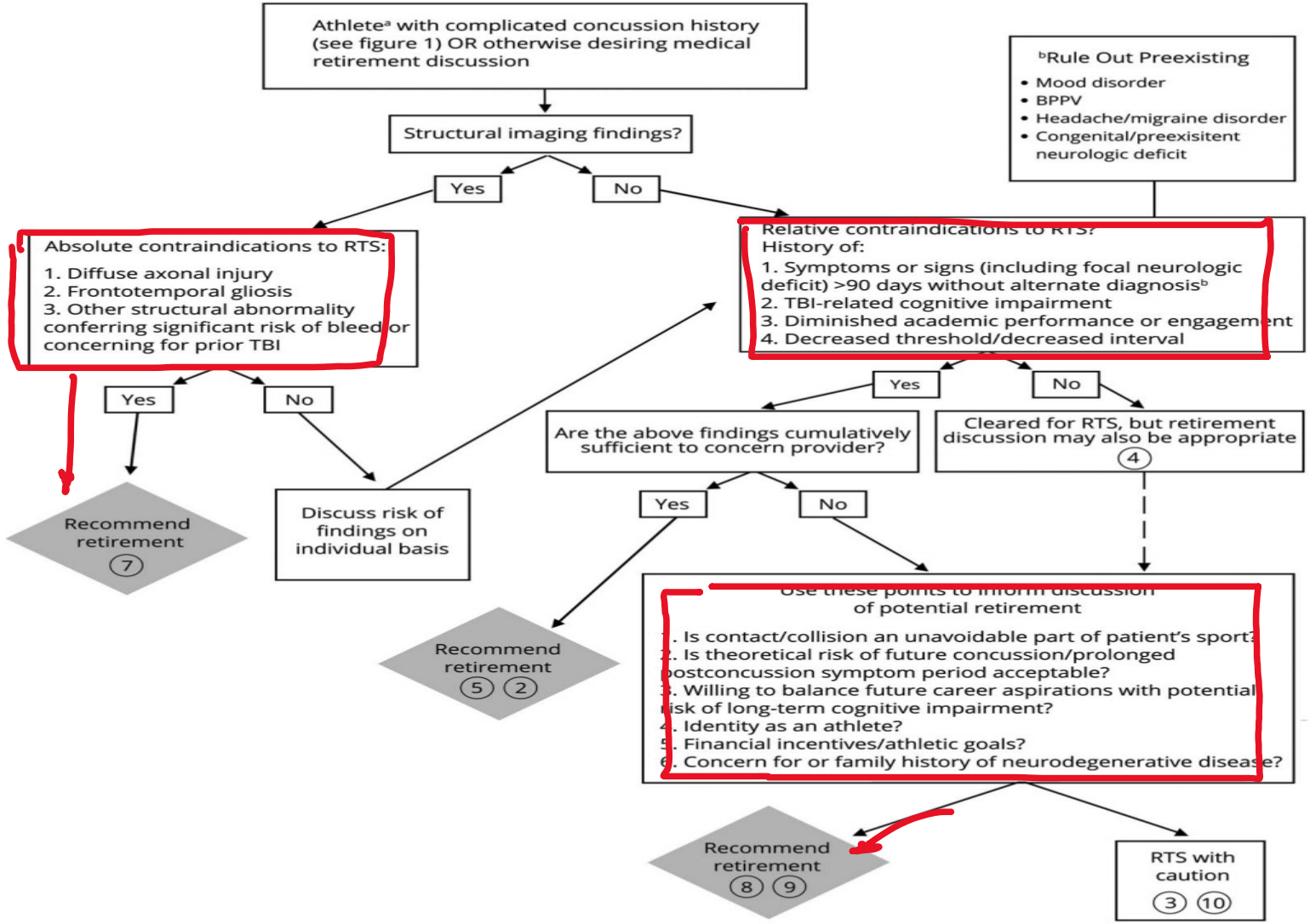
Figure 1 Considerations for concussed athletes leading to medical care or return to sport (RTS)



The circled numbers included in the boxes at many of the endpoints correspond to the patient case numbers described in the prior section. LOC = loss of consciousness; RTL = return to learn; SRC = sports-related concussion.

Figure 2 Provider decision algorithm: Considerations in retirement discussion and recommendation



The circled numbers included in the boxes at many of the endpoints correspond to the patient case numbers described in the prior section. [a]Ideally, athlete is asymptomatic at time of discussion. [b]Reference the "Rule out preexisting" box located at the top right of the figure. BPPV = benign paroxysmal positional vertigo; RTS = return to sport; TBI = traumatic brain injury.

Current/future tech for objective diagnosis

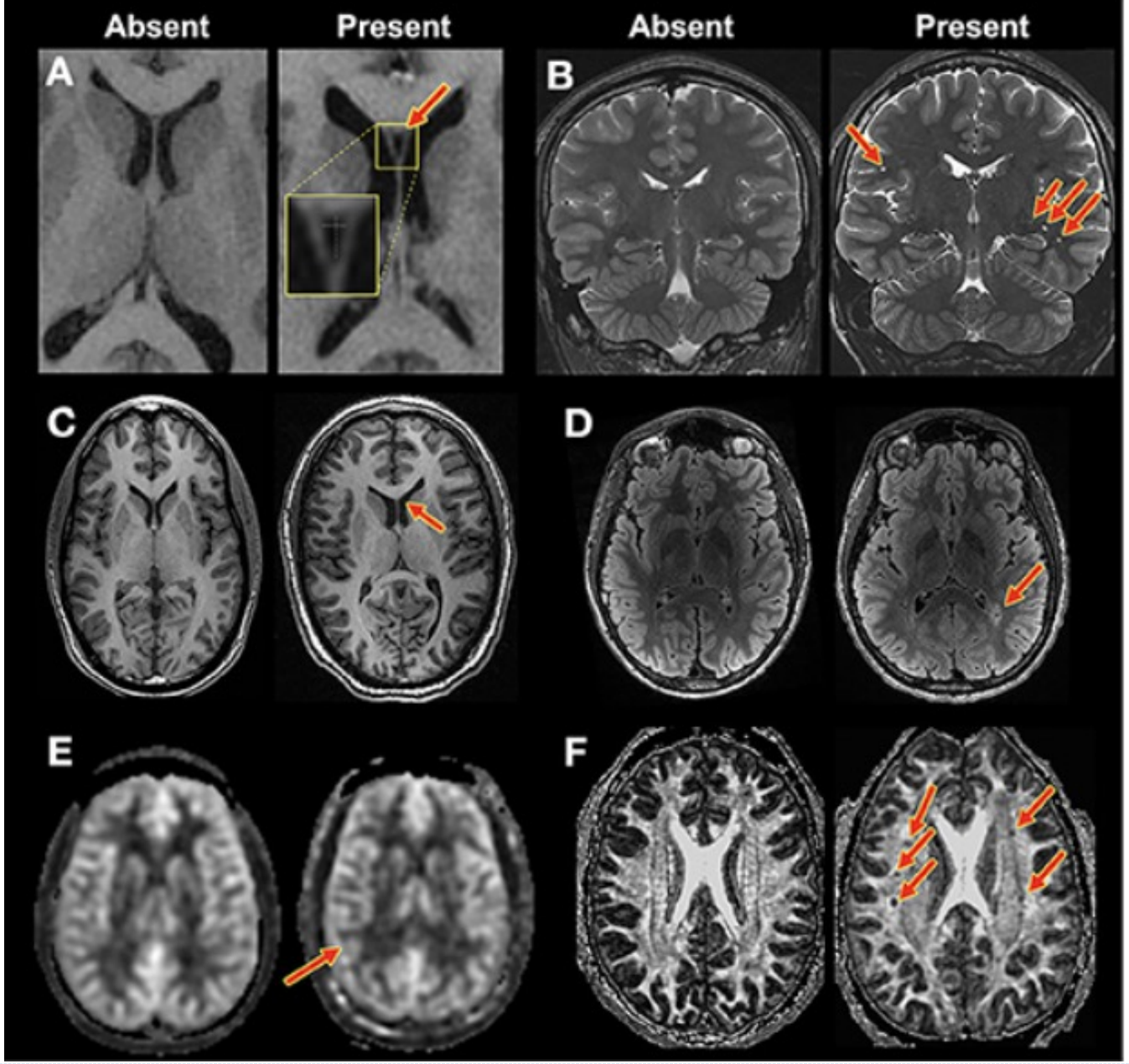
- MRI
- SWAY, IMPACT, ETC
- DTI
- BIOMARKERS
- OCULAR MOTION ANALYSIS
- MOBILE EEG (BUILT INTO HELMETS – NOMO)

Don't say the "C" word!

ORIGINAL RESEARCH article
Front. Neurol., 11 August 2021
Sec. Neurotrauma
Volume 12 - 2021 | https://doi.org/10.3389/fneur.2021.701948

Neuroradiologic Evaluation of MRI in High-Contact Sports

ATHLETES CONTINUE TO UNDERREPORT



Over-reliance on "objective testing" may lead to missed diagnoses and unwanted outcomes of sport-related concussions.

Case example #1

- 20 y/o Male Lacrosse Player, Long Stick Defender
- Date of Injury: 10/13/2023
- Date of Evaluation: 12/7/2023
- Head-to-head contact during practice after being checked in the back on a face off.
- Did not notice significant symptoms initially. Participated in a scrimmage the following day with worsening symptoms without trauma.
- No exertional protocol/academic modifications. Treating symptoms with Tylenol and rest.
- Did not improve over two months and was referred to see us.

Case 1 cont'd:

- No family history of headaches or migraines.
- No history of anxiety or depression
- History of stage IV Lyme Disease in 4th grade which was treated over two years.
  - (still concerned about sequelae of this disease)
- History of autonomic nervous system dysfunction including postural dizziness, exercise intolerance.
  - Postural Orthostatic Tachycardia Syndrome (POTS) ruled out by Cardiologist
- One prior concussion in 2020, head-to-head contact with opposing player. No LOC or amnesia.
  - CT scan at emergency room was negative

Case 1 cont'd: Physical Exam

- Paresthesia to the left 5th digit
- CN 2-12 intact
- Normal sensory and motor examination
- Symptomatic with VMS testing

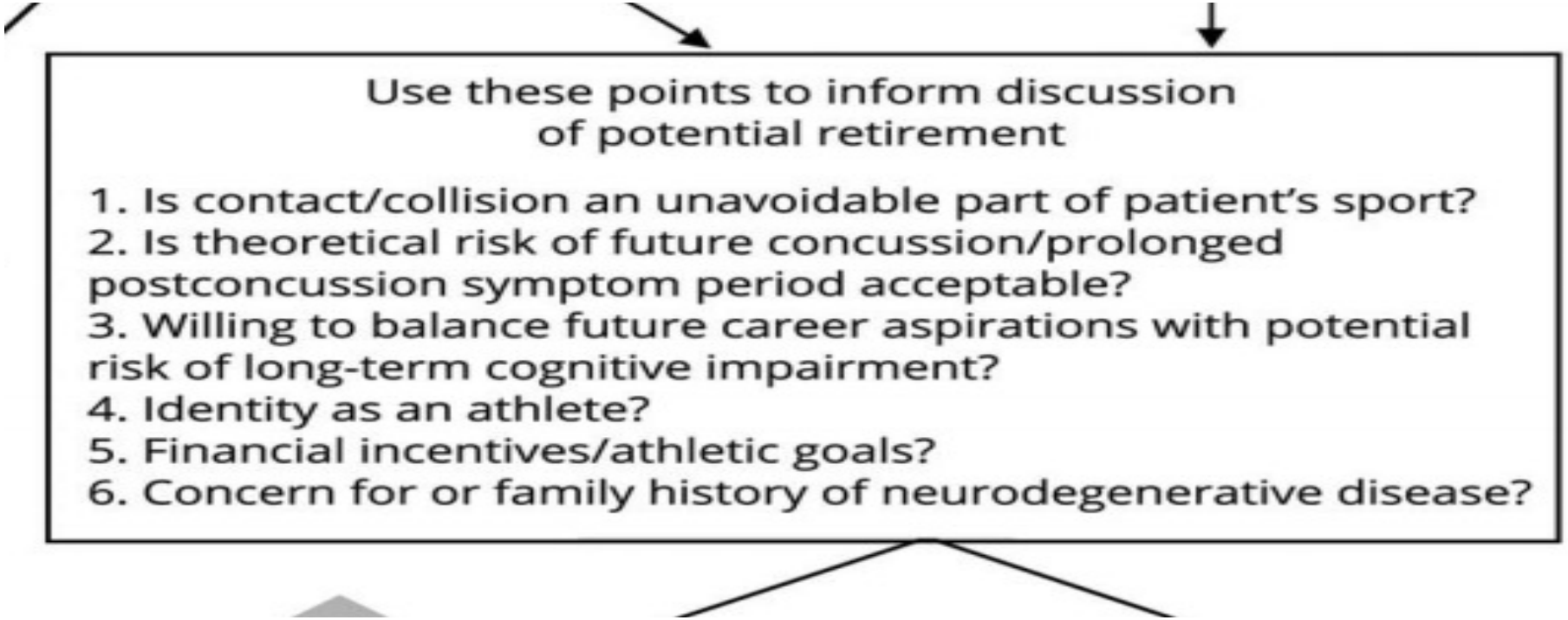
Case 1 cont'd: Plan

- Initiate exertional protocol
- Academic modifications for school (allow for deferred final exams as he was about to start winter break)
- MRI of the Brain and cervical spine ordered due to history and persistent symptoms.
- Nortriptyline 25 mg prescribed
- Encouraged to monitor HRV (ANS)

Case 1 cont'd: follow up

- Asymptomatic as of 1/11/2024 with occasional neck pain (prolonged recovery.) *importance of timing of treatment
- Wanted to return to play without restriction as scrimmages were beginning
- MRI Brain structurally normal
- MRI of the cervical spine reviewed today reveals significant changes at C3-4 and C6-7.
  - The left-sided foraminal compromise at the C6-7 level is moderate without nerve root compression, and the C3-4 level has right-sided foraminal narrowing

Shared Decision-Making



Case Example 2:

- 21 y/o Defensive End
- Date of injury 11/11/2023
- Date of evaluation: 11/20/2023
- MOI: when making tackle on opposing running back, slammed his head on the field. Multiple contacts after this injury.
- NO LOC. Amnesia after last game of the season.
- Noticed symptoms immediately (headaches, paresthesia) **but did not feel that they were severe enough to report at that time as he wanted to finish the season.**

Case 2 cont'd:

- Symptoms worsening with academics and lifts with the team.
- Treating symptoms with Tylenol.
- History of headaches secondary to dehydration, which started at age 15
- One prior concussion at age 14, playing baseball, as he was sliding into home plate, catcher punched him in face. LOC for <30 seconds.
  - CT scan negative at hospital
  - Returned to sport after one month

Case 2 cont'd: physical exam

- Left sided SCM tenderness which reproduces headaches
- Cranio-cervical junction tenderness
- Cranial nerves 2-12 intact
- + symptoms with eye tracking
- +symptoms with convergence which is >10cm
- + symptoms with VMS

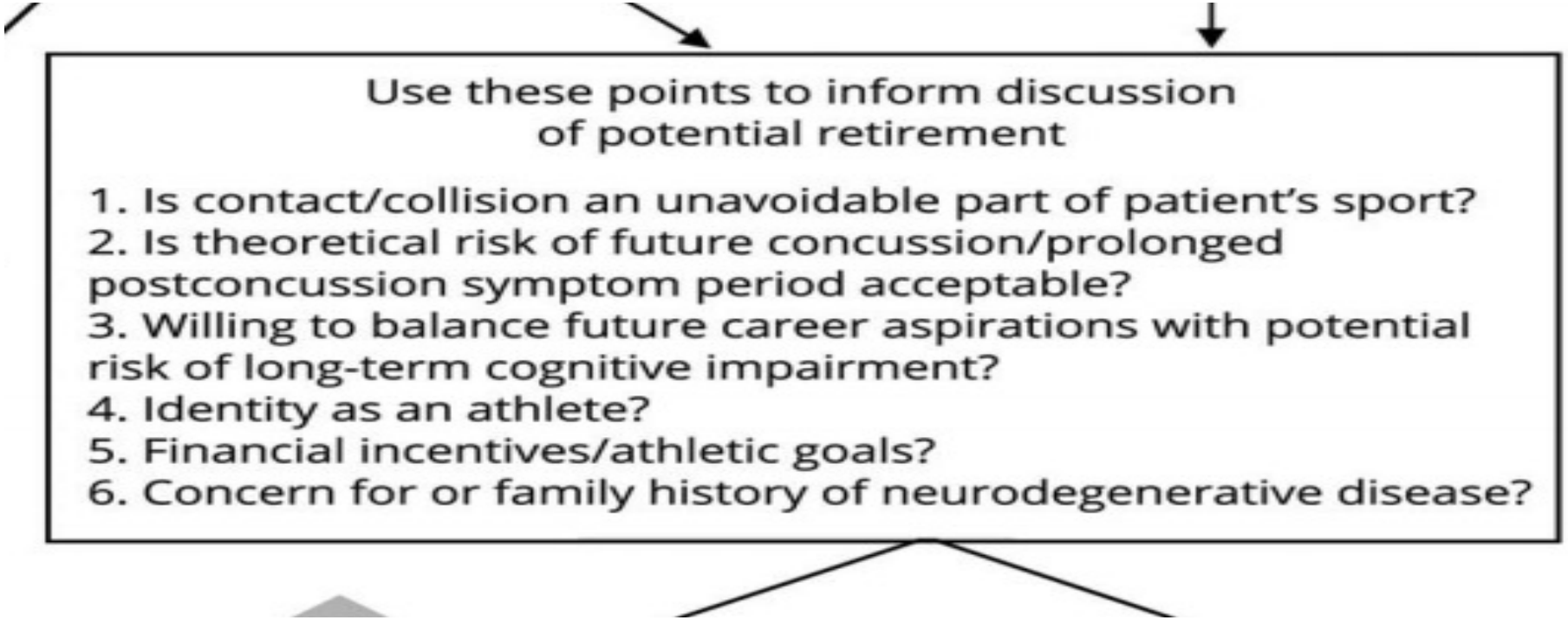
Case 2 cont'd: plan

- Initiate exertional protocol
- Ocular exercises at bedtime (convergence deficit)
- Melatonin 5-10mg to help with sleep. Consider Benadryl
- Academic restrictions as he is not able to focus, concentrate or study. Will work with student disability services for make-up finals, speech to text/text to speech, one on one tutoring, printed materials.
- MRI of Brain and C-spine ordered.

Case 2 cont'd: Follow up

- MR of Brain was normal.
- MR of cervical spine consistent with neck sprain of the posterior intervertebral ligament without disruption of disc. C5-c6 disc desiccation and reversal of normal curvature C4-C6.
- He continues to have persistent concussion symptoms which are cognitive dominant.
- Neuropsychological testing ordered
- Consider leave of absence from school for the semester to focus on rehabilitation.

Shared Decision-Making



Case example 3:

- 20 y/o male Defensive back Columbia University Football
- DOI: 11/17/2023
- Date of evaluation: 11/30/2023
- Made a tackle hitting his head on opposing player's knee in third quarter.
- No LOC.
- Retrograde Amnesia (does not remember events that occurred after the third play of the game leading up to injury).

Case 3 cont'd:

- Denies any prior concussions
- Not taking any medications
- Symptom provocation with academics
- Two day prior to this injury, he had his "bell rung" while making a tackle on a kickoff during practice. Headaches, dizziness, and neck pain which lasted about 10 minutes. He did not report at that time.

Case 3 cont'd: Physical Exam

- Positive Spurling's test
- Cranial nerves 2-12 intact
- + symptoms with Saccadic motion, Gaze stability, Visual motion sensitivity.
- Convergence deficiency

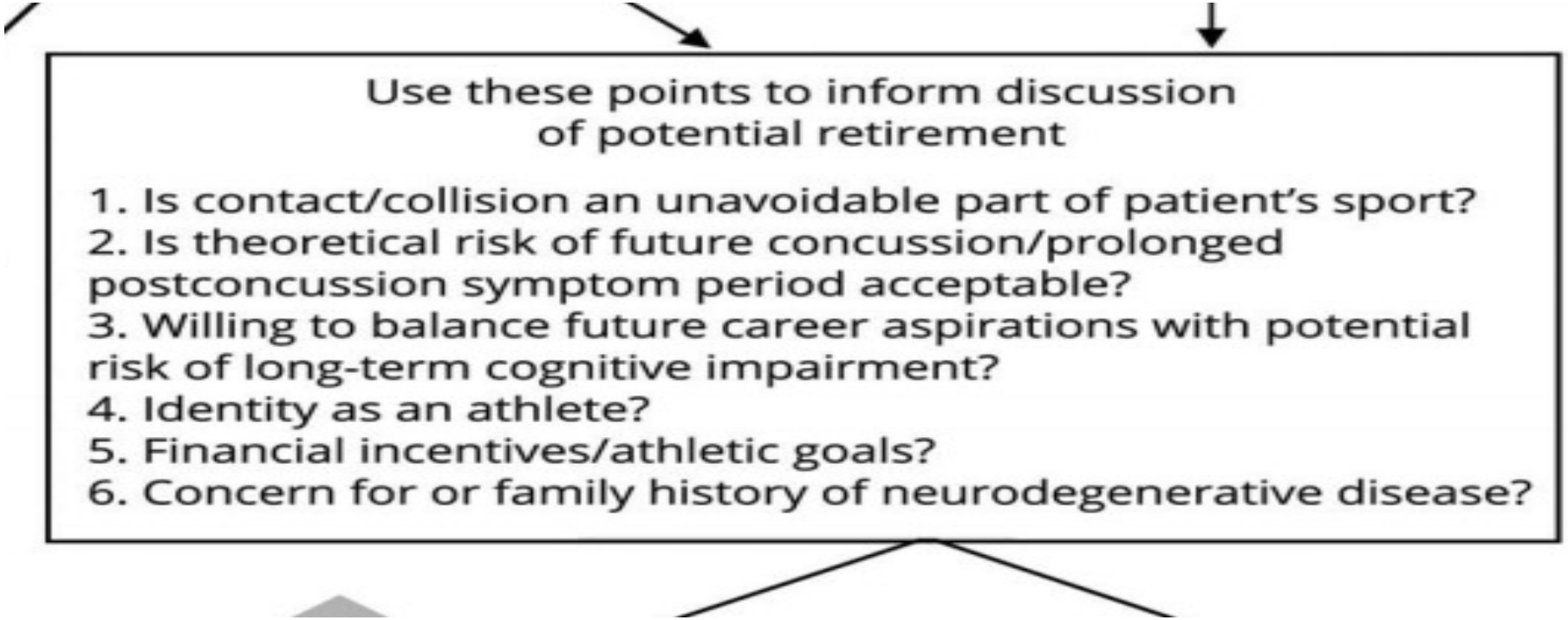
Case 3 cont'd: Plan

- Exertional protocol initiated
- MRI of Brain
  - Small cortical focus of hyperintense T2/FLAIR signal at the right posterior temporal/occipital junction which may represent sequela of prior trauma. Suggestion of low SWI signal is seen in this region, which may represent minimal microhemorrhage or vessel on end. He returned for SWI sequence on 3 tesla magnet to evaluate for additional microhemorrhages 6 weeks later was normal. Previously noted punctate signal abnormalities are not appreciated on this evaluation.

Case 3 cont'd: Follow up

- Nortriptyline 25mg prescribed after 4 weeks of persistent headaches
- Was able to tolerate increased heart rate on stationary bike after 6 weeks.
- Asymptomatic at 2 month follow up*

Shared Decision-Making



Case 4 Example:

- 22 y/o female club wrestling
- Date of injury: 1/28/2024
- Date of evaluation 2/20/2024
- MOI: taken down by opponent causing whip-lash type injury with her head on the mat. No LOC or Amnesia.
- She did not continue participation in the match. Was held out by ONSITE athletic trainer.
- Broken teeth but no jaw fracture.
  - Had three crowns put in 3 days prior to evaluation

Case 4 cont'd:

- Taking Aleve and Tylenol to help with headaches.
- Having difficulty with academics, concentrating.
  - Her therapist thinks this may be related to ADHD but no formal diagnosis.
- Feeling slightly more anxious than normal.
- One prior concussion in 2015, slipped on ice and hit the back of her head. Was symptomatic for 2 weeks.
- H/O migraines which started at age 12.
  - Amitriptyline 25mg daily
  - Recently started taking Buproprion
  - Attends therapy monthly
  - Mother has history of migraines
  - Has neurology consultation scheduled.

Case 4: Physical exam

- Normal cervical examination
- Cranial nerves 2-12 intact
- Normal motor and sensory examination.
- No symptoms with Ocular testing on examination.

Case 4: Plan

- Exertional protocol (starting with the stationary bike. When tolerating 170bpm, add in jogging/running)
- Academic modifications
- Caffeine/Tea for ADHD
- Box breathing
- SYMPTOMS ABATED AFTER ONE WEEK

THANK YOU.

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