

# **PRACTICAL STRATEGIES FOR RETURN-TO-ACTIVITIES FOLLOWING SPORT CONCUSSION**

**MICHAEL HUTCHISON, PhD RKin**  
Faculty of Kinesiology & Physical Education  
David L. MacIntosh Sport Medicine Clinic  
University of Toronto

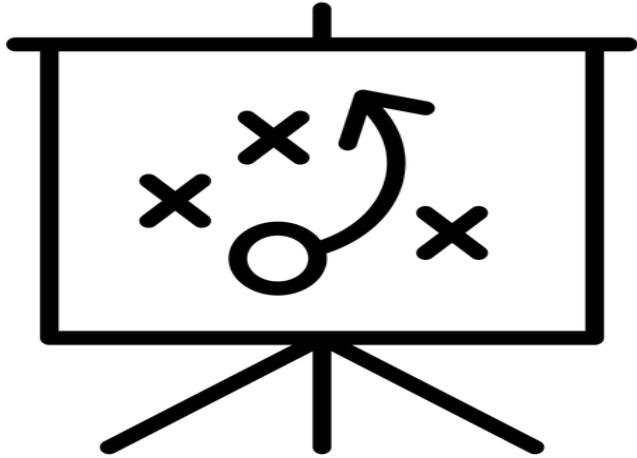


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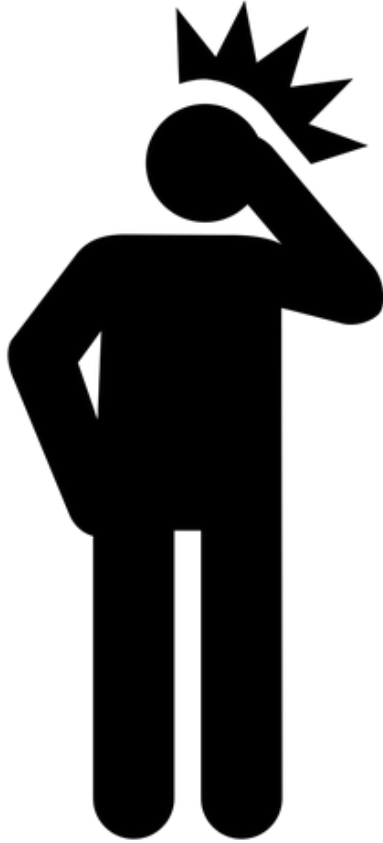
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# LEARNING OBJECTIVES



1. Review the rationale and stages for return-to-play guidelines.
2. Identify and discuss common stressors that should be considered in acute concussion management and return-to-activity progressions.
3. Discuss the rationale and possible strategies for exercise as an intervention for those with persistent symptoms.





# CONCUSSION IS

Type of Traumatic Brain Injury

Clinical Syndrome – Event + Signs and/or Symptoms

Caused by Direct or Indirect contact

Standard Medical Imaging = Normal

Each Concussion is Different – May Involve One or Many Patho-Anatomic Elements



# SPORT CONCUSSION ASSESSMENT TOOL (SCAT)



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## SYMPTOM EVALUATION

3

### How do you feel?

"You should score yourself on the following symptoms, based on how you feel now".

	none	mild	moderate	severe
Headache	0	1	2	3
"Pressure in head"	0	1	2	3
Neck Pain	0	1	2	3
Nausea or vomiting	0	1	2	3
Dizziness	0	1	2	3
Blurred vision	0	1	2	3
Balance problems	0	1	2	3
Sensitivity to light	0	1	2	3
Sensitivity to noise	0	1	2	3
Feeling slowed down	0	1	2	3
Feeling like "in a fog"	0	1	2	3
"Don't feel right"	0	1	2	3
Difficulty concentrating	0	1	2	3
Difficulty remembering	0	1	2	3
Fatigue or low energy	0	1	2	3
Confusion	0	1	2	3
Drowsiness	0	1	2	3
Trouble falling asleep	0	1	2	3
More emotional	0	1	2	3
Irritability	0	1	2	3
Sadness	0	1	2	3
Nervous or Anxious	0	1	2	3

Total number of symptoms (Maximum possible 22)

Symptom severity score (Maximum possible 132)

Do the symptoms get worse with physical activity? ☐ Y ☐ N

Do the symptoms get worse with mental activity? ☐ Y ☐ N

☐ self rated ☐ self rated and clinician monitored

☐ clinician interview ☐ self rated with parent input

**Overall rating:** If you know the athlete well prior to the injury, how different is the athlete acting compared to his/her usual self?

Please circle one response:

☐ no different ☐ very different ☐ unsure ☐ N/A

## COGNITIVE & PHYSICAL EVALUATION

4

### Cognitive assessment

Standardized Assessment of Concussion (SAC)<sup>4</sup>

**Orientation** (1 point for each correct answer)

What month is it?	0	1
What is the date today?	0	1
What is the day of the week?	0	1
What year is it?	0	1
What time is it right now? (within 1 hour)	0	1

Orientation score of 5

**Immediate memory**

List	Trial 1	Trial 2	Trial 3	Alternative word list
elbow	0	1	0	1
apple	0	1	0	1
carpet	0	1	0	1
saddle	0	1	0	1
bubble	0	1	0	1
Total				

Immediate memory score total of 15

**Concentration: Digits Backward**

List	Trial 1	Alternative digit list
4-9-3	0	1
3-8-1-4	0	1
6-2-9-7-1	0	1
7-1-8-4-6-2	0	1
Total of 4		

**Concentration: Month in Reverse Order** (1 pt. for entire sequence correct)

Dec-Nov-Oct-Sept-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan	0	1
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Concentration score of 5

6

### Balance examination

Do one or both of the following tests.

Footwear (shoes, barefoot, braces, tape, etc.)

**Modified Balance Error Scoring System (BESS) testing<sup>5</sup>**

Which foot was tested (i.e. which is the non-dominant foot) ☐ Left ☐ Right

Testing surface (hard floor, field, etc.)

**Condition**

Double leg stance: Errors

Single leg stance (non-dominant foot): Errors

Tandem stance (non-dominant foot at back): Errors

**And/Or**

**Tandem gait<sup>6,7</sup>**

Time (best of 4 trials): seconds

7

### Coordination examination

**Upper limb coordination**

Which arm was tested: ☐ Left ☐ Right

Coordination score of 1

8

### SAC Delayed Recall<sup>4</sup>

Delayed recall score of 5



# Prospective Clinical Assessment Using Sideline Concussion Assessment Tool-2 Testing in the Evaluation of Sport-Related Concussion in College Athletes

*Margot Putukian, MD,\*† Ruben Echemendia, PhD,‡§ Annegret Dettwiler-Danspeckgruber, EdD,¶  
Tawny Duliba,¶ Jared Bruce, PhD,‡ John L. Furtado, PT, ATC,\* and Murali Murugavel, PhD¶*

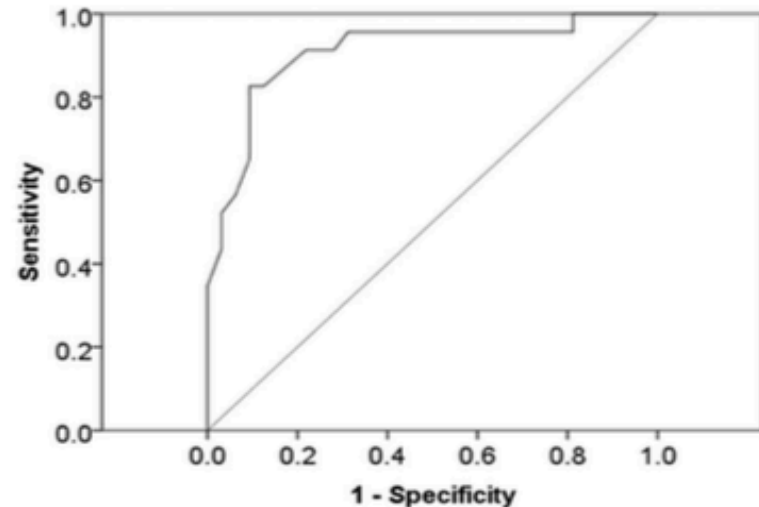
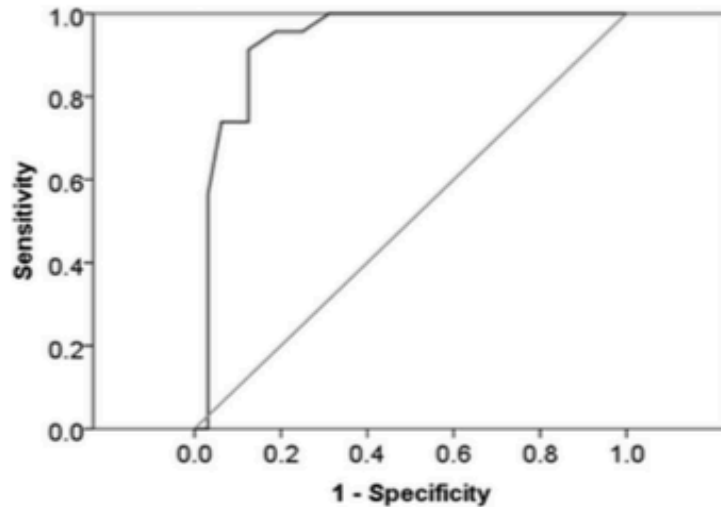
*Clin J Sport Med Vol 25 V1, Jan 2015*

## Overall score

Test domain	Score
Symptom score	of 22
Physical signs score	of 2
Glasgow Coma score (E + V + M)	of 15
Balance examination score	of 30
Coordination score	of 1
<b>Subtotal</b>	<b>of 70</b>
Orientation score	of 5
Immediate memory score	of 5
Concentration score	of 15
Delayed recall score	of 5
<b>SAC subtotal</b>	<b>of 30</b>
<b>SCAT2 total</b>	<b>of 100</b>



- **Concussed athletes** – Increase (worse) from baseline to post-injury for the SCAT-2 total score, symptom severity score, total symptoms, and more errors on BESS.
- **No significant** change was noted for concussed athletes on the SAC.



# SCAT3 – COGNITIVE SCORES

Baseline Scores



Sideline Scores



1<sup>st</sup> MD Visit



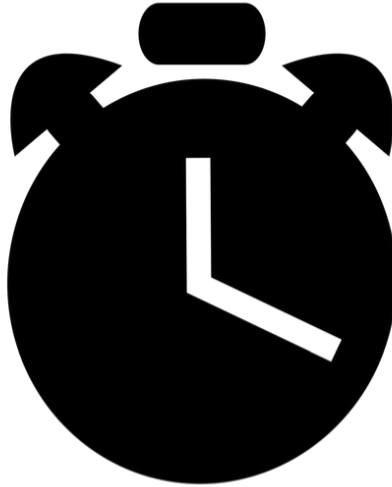
3-5 Days from Injury

1. Orientation Score = No sig. change
2. Immediate Memory = No sig. change
3. Digits Backward = No sig. change
4. Concentration = No sig. change
5. Delayed Recall = No sig. change

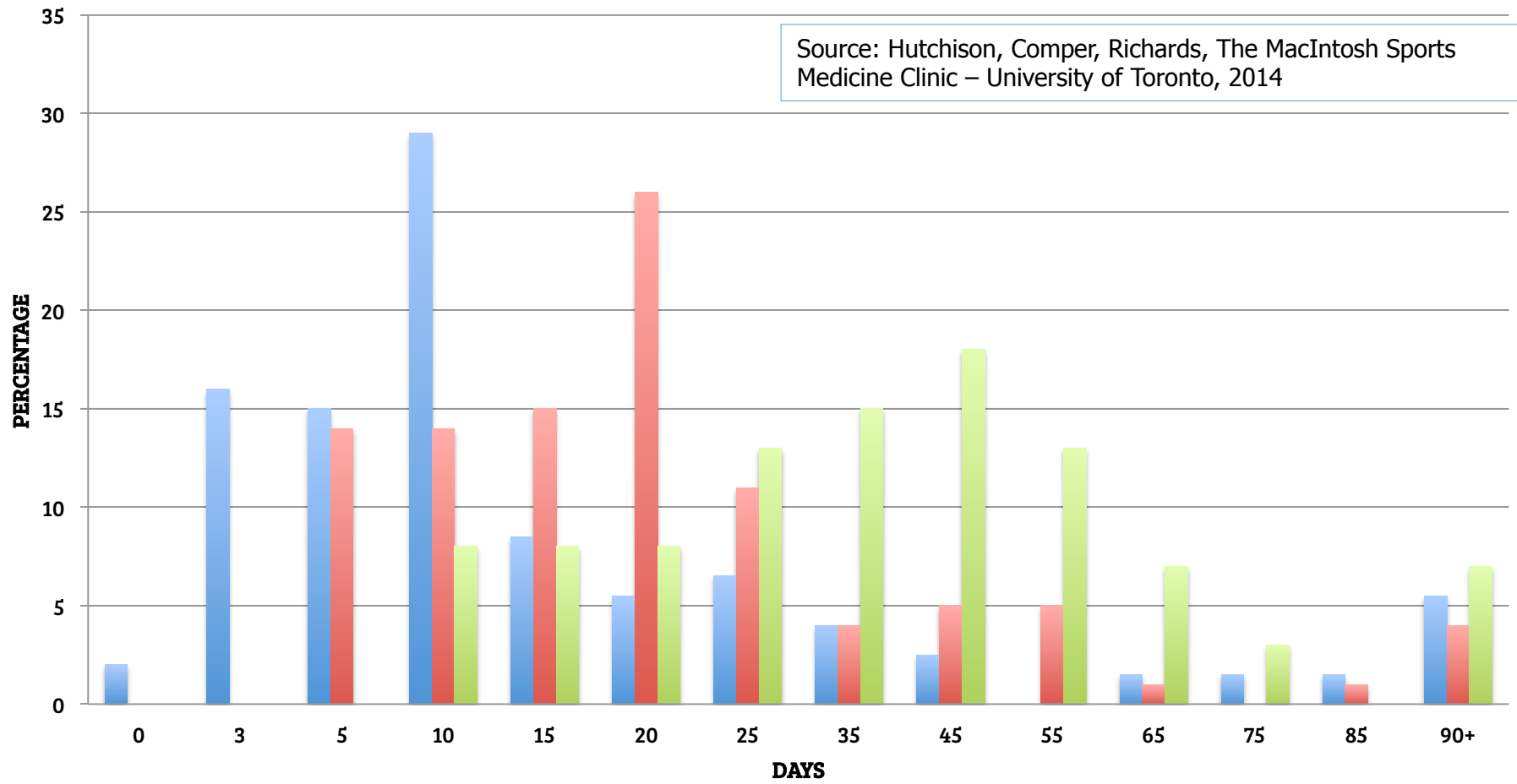




# WHAT IS “NORMAL” RECOVERY TIME?



Source: Hutchison, Comper, Richards, The MacIntosh Sports Medicine Clinic – University of Toronto, 2014



# **CURRENTLY ACCEPTED MANAGEMENT PRINCIPLES FOR CONCUSSION ARE:**



**REST**



**EDUCATION**



**RE-INTEGRATION**



# INITIAL REST

- **Complete whole-person rest**
  - physical
  - cognitive
  - sensory
  - social
- **How long?**
  - Historically until symptoms abate, usually 1 to 2 (?) weeks
  - Recent trend to shorten this; many prospective studies of early exercise or other active Rx underway– awaiting results;





## **ANIMAL MODEL RESEARCH**

**“metabolic crisis”**



## **CLINICAL RESEARCH**

**increase in number and severity of symptoms  
longer recovery times**



## **COMMON SENSE**

**reduces the likelihood of another injury**



CLINICAL SCIENCES

## Acute Lower Extremity Injury Rates Increase after Concussion in College Athletes

ROBERT C. LYNALL<sup>1,2</sup>, TIMOTHY C. MAUNTEL<sup>2,3</sup>, DARIN A. PADUA<sup>2,3</sup>, and JASON P. MIHALIK<sup>1,2,4</sup>  
<sup>1</sup>Matthew Gfeller Sport-Related Traumatic Brain Injury Research Center, Department of Exercise and Sport Science, University of North Carolina, Chapel Hill, NC; <sup>2</sup>Curriculum in Human Movement Science, Department of Allied Health Sciences, School of Medicine, University of North Carolina, Chapel Hill, NC; <sup>3</sup>Sports Medicine Research Laboratory, Department of Exercise and Sport Science, University of North Carolina, Chapel Hill, NC; and <sup>4</sup>Injury Prevention Research Center, University of North Carolina, Chapel Hill, NC

### ABSTRACT

LYNALL, R. C., T. C. MAUNTEL, D. A. PADUA, and J. P. MIHALIK. Acute Lower Extremity Injury Rates Increase after Concussion in College Athletes. *Med. Sci. Sports Exerc.*, Vol. 47, No. 12, pp. 2487–2492, 2015. Dynamic postural control deficits and disrupted cortical pathways have been reported to persist beyond an athlete's return to activity after concussion, potentially increasing the risk of acute lower extremity musculoskeletal injury. **Purpose:** This study aimed to investigate acute lower extremity musculoskeletal injury rates before and after concussion in athletes with concussion and their matched control. **Methods:** College athletes with concussion ( $n = 44$ ; age,  $20.0 \pm 1.2$  yr) were physician-diagnosed. Nonconcussed college athletes ( $n = 58$ ; age,  $20.5 \pm 1.3$  yr) were matched to individuals with concussion. Acute lower extremity musculoskeletal injury data were collected for 2 yr ( $\pm 1$  yr of the diagnosed concussion) using electronic medical records. Control participants' 2-yr window for exposure and musculoskeletal injury data were anchored to their match's concussion injury date. Pre- and postconcussion musculoskeletal injury rates were calculated for 90-, 180-, and 365-d periods for both study cohorts. Risk ratios were calculated to determine differences within and between groups for all periods. **Results:** Within 1 yr after concussion, the group with concussion was 1.97 (95% confidence interval [CI], 1.19–3.28;  $P = 0.01$ ) times more likely to have experienced an acute lower extremity musculoskeletal injury after concussion than before concussion and 1.64 times (95% CI, 1.07–2.51;  $P = 0.02$ ) more likely to have experienced an acute lower extremity musculoskeletal injury after concussion than their matched nonconcussed cohort over the same period. Up to 180 d after concussion, the group with concussion was 2.02 (95% CI, 1.08–3.78;  $P =$

- Within 1 yr after concussion, the group with concussion was 1.97 (95% confidence interval [CI], 1.19–3.28;  $P = 0.01$ ) times **more likely to have experienced** an acute lower extremity musculoskeletal injury after concussion than before concussion



# WHEN REST IS OVER... WHAT'S NEXT?



# ZURICH GUIDELINES (2012)



**ATHLETE**

REHABILITATION STAGE	FUNCTIONAL EXERCISES	OBJECTIVE
1. No activity	Complete physical and cognitive rest	Recovery
2. Light aerobic exercise	< 70% max HR	Increase HR
3. Sport specific exercise	Drills with no head impact	Add movement
4. Non contact drills	Progression to more complex drills	Exercise, cognitive load, coordination
5. Full contact practice	Normal training	Restore confidence and functional skills
6. Return to play	Normal game play	

**RETURN TO PLAY**





# RETURN-TO-ACTIVITY PROGRESSIONS

- Increasing attention to **other aspects of life:**
  - school, work, social activity, technology, etc.
- Return-to-Activity (RTA) principle:
  - concussed individuals should be exposed **to as much “stress”** (next slides) as can be tolerated without exacerbation or relapse of manifestations of disorder
  - fundamental belief that **provocation of symptoms and signs is a “setback”**; i.e. – it will **delay or prevent complete recovery**;  
lack of evidence of this, but prudence until proven otherwise



# UT MACINTOSH CLINIC RTA PROGRESSIONS

- We now consider **RTA as a 4 x 3 x 6 matrix:**
- **4 domains of life**
  - school, sport/PA, work, social
- **3 categories of stressor** in each domain
  - physical, cognitive, sensory
- **6 stages of progression** of each category:
  - rest, re-introduce, progress x 2, submaximal, normal



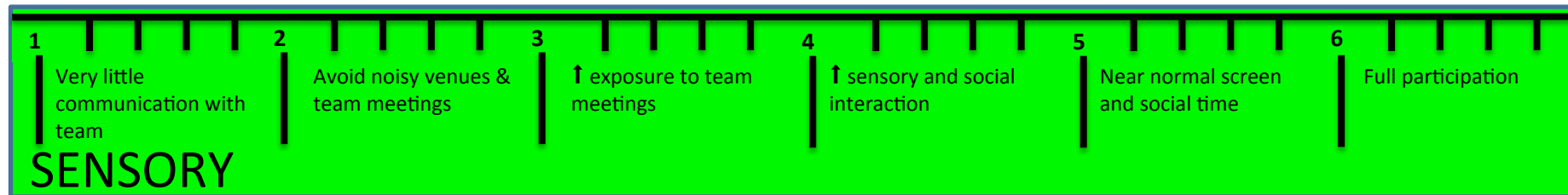
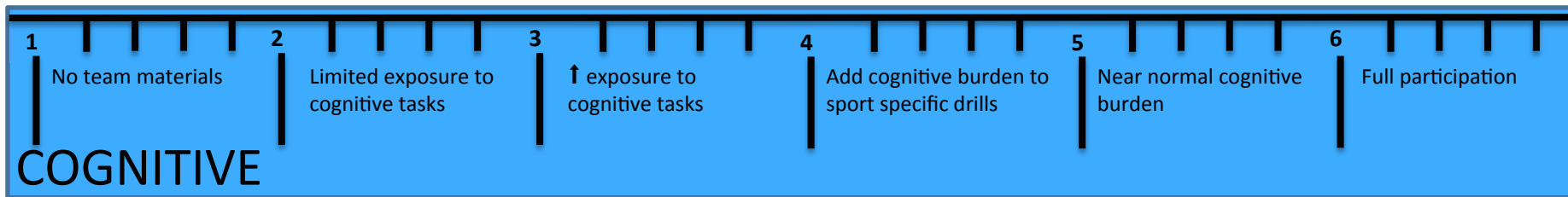
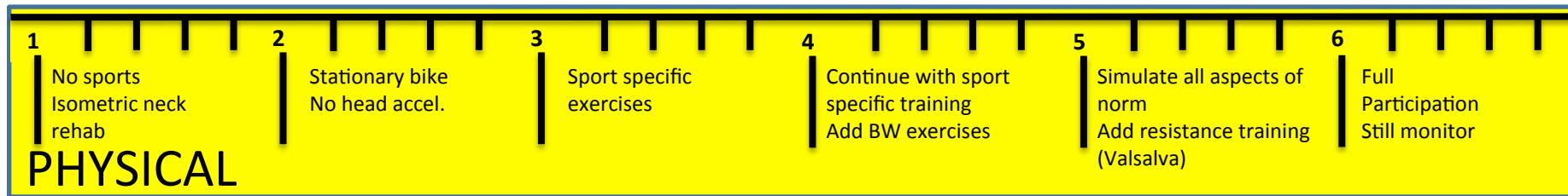
# SPORT PLAY



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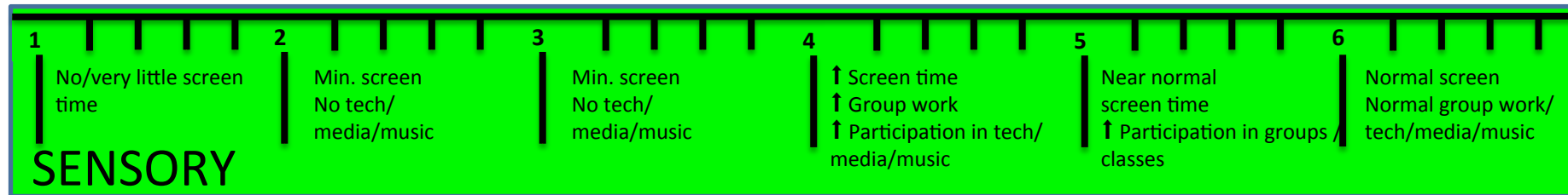
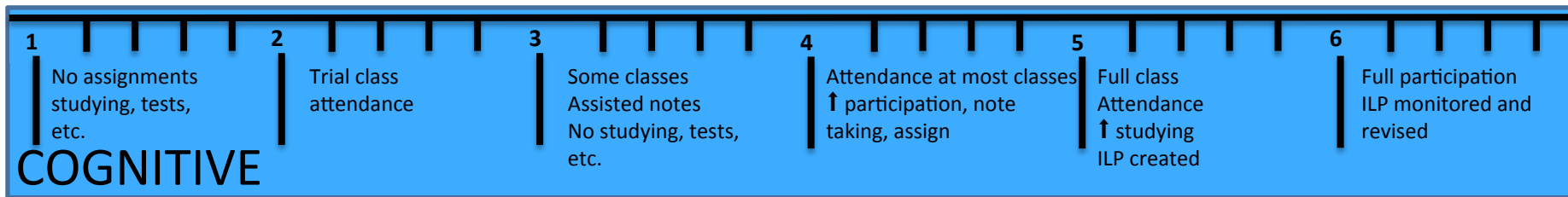
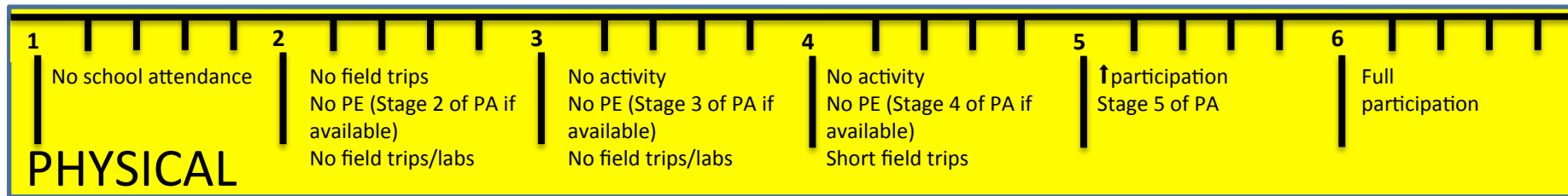
# SCHOOL



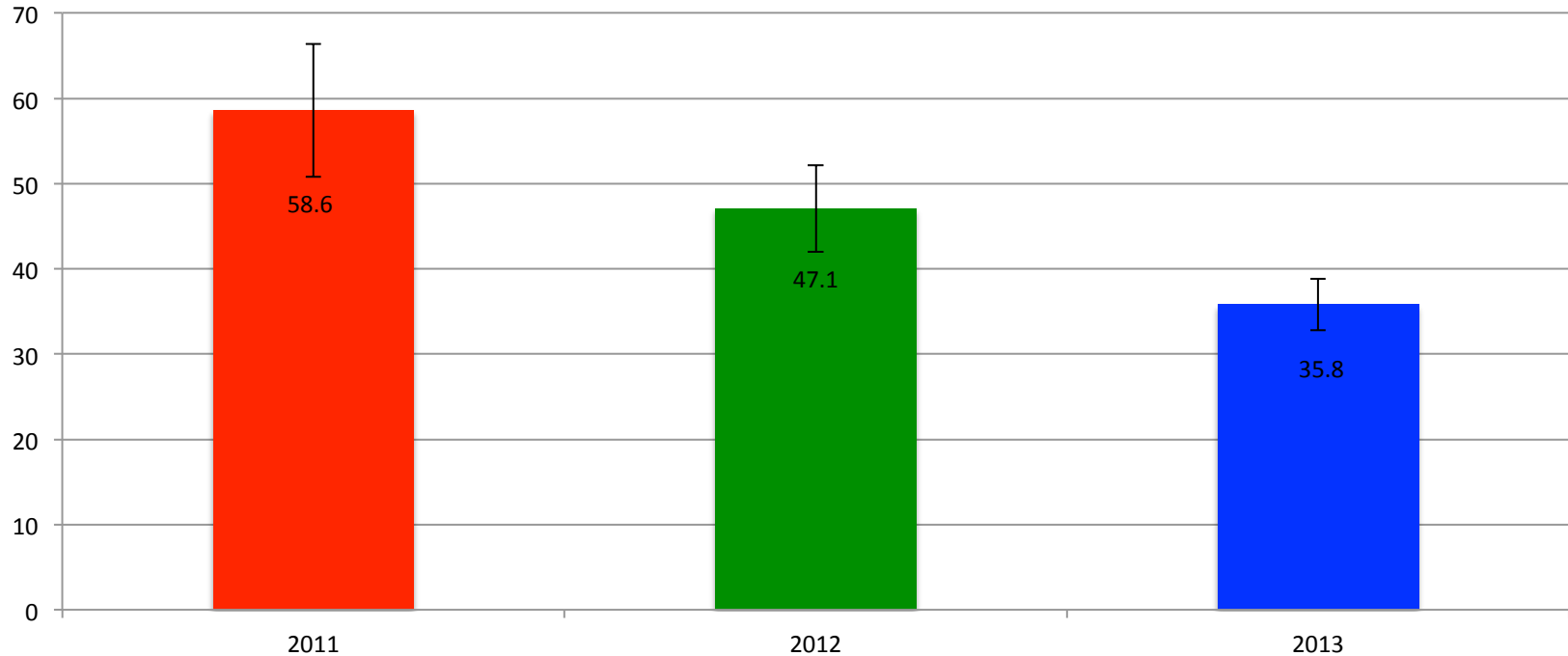
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# DAYS TO MEDICAL CLEARANCE BY YEAR



# WORKSHOP ACTIVITY

- Develop a **sport-specific exercise progression** for Stages 3 and 4 (based on UT schema):
  - **Stage 3**
    - sport specific whole body and head movement
    - introduce planes of movement sequentially
    - gradual ramp of intensity (acceleration) and volume
  - **Stage 4**
    - sport-specific drills requiring attentional burden (esp. visual and cognitive attention)
    - gradual ramp of intensity and volume





# PERSISTENT SYMPTOMS

## What about the 15-20%?

Historically considered “not recovered” = rest

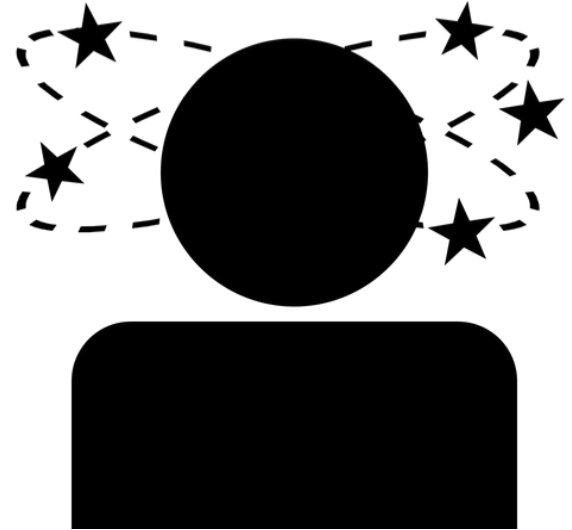
## What is the evidence for rest?

Largely assumed rather evidence based (animal and limited clinical research)

## There are several possible problems with rest

Other health conditions can be

1. improved by exercise
2. not addressed
2. worsened by inactivity



# PERSISTENT SYMPTOMS

Vestibular

Headache Disorder

Oculomotor

Mood / Affect

Cervicogenic

Physiological



# ROLE OF STRUCTURED EXERCISE

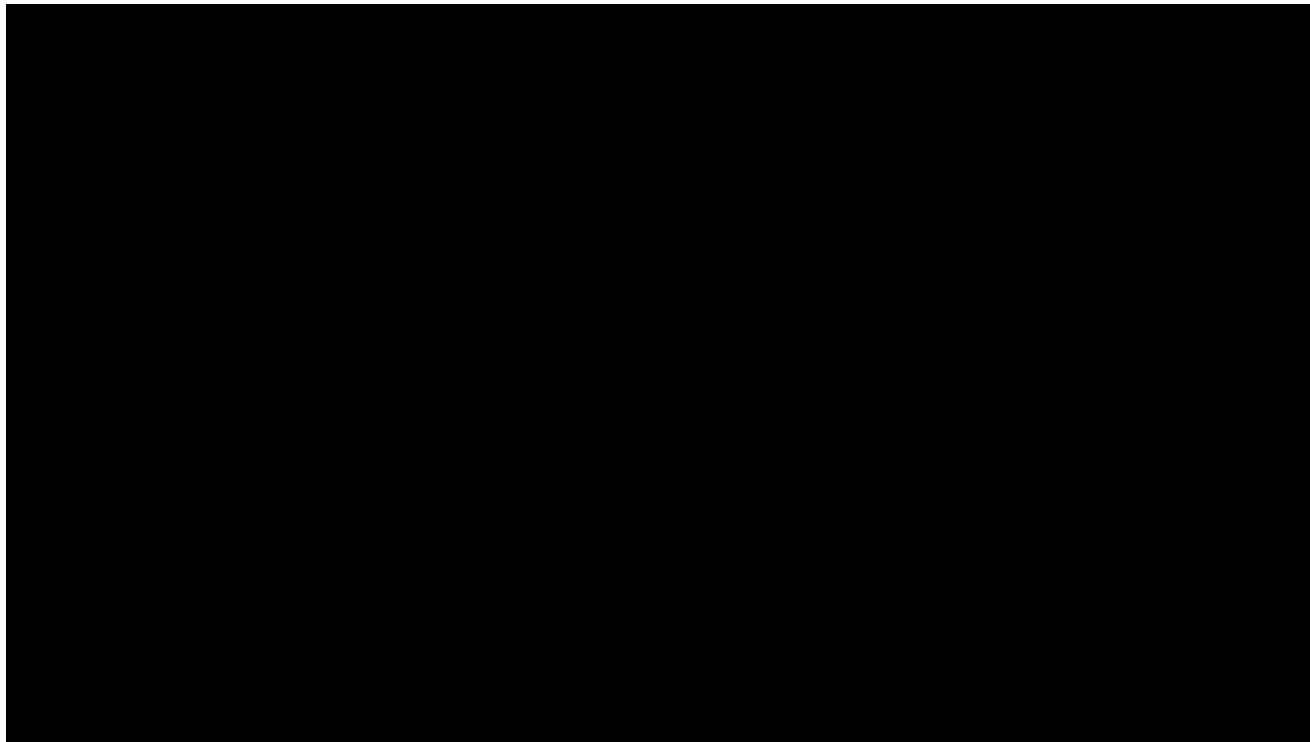
- Portion of patients may still be recovering
  - alterations in cell membrane permeability, ion cellular metabolism and cerebral blood flow.
  - **ANS dysfunction?** > Sympathetic output
- Exercise increase parasympathetic activity, decrease sympathetic activity
- Neurotrophic factors - BDNF



# WHAT DOES IT “LOOK” LIKE?

- **Graded aerobic treadmill** tests have emerged as a safe, reliable and effective tool.
  - John Leddy, Barry Willer and colleagues (UofB)
  - Patients prescribed aerobic exercise for the same duration they achieved during treadmill testing but at 80% of the maximum heart rate achieved, once daily, 5–6 days a week, with use of a digital heart rate monitor.
- University of Toronto / MacIntosh Clinic
  - Insert them at Stage 2 of PA progressions – **Stationary Bike**
  - Goal aerobic > intensity & length > intervals





# PERSISTENT SYMPTOMS

Vestibular

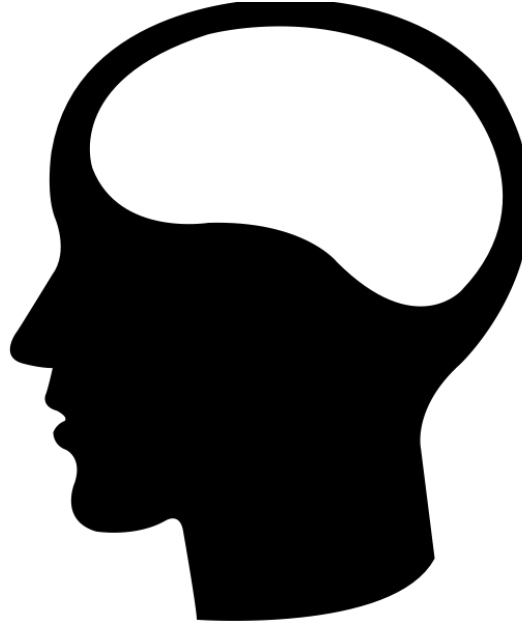
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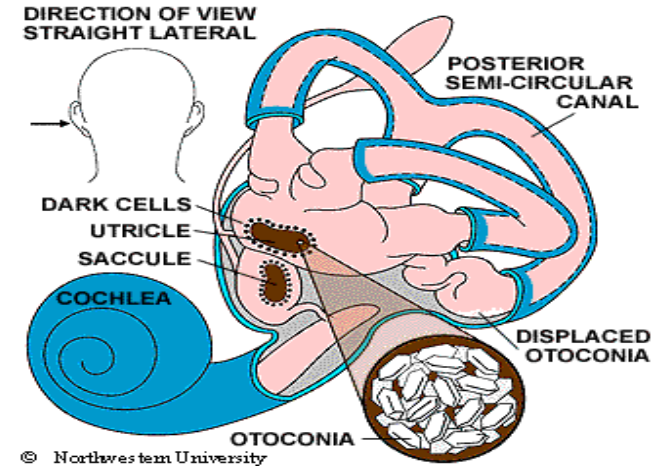
# NECK REHAB (AND PREHAB)

- **Prevention:** isometric and dynamic stabilization
- **Immediate:**
  - isometric neutral posture stabilization
  - avoid (excessive) movements / manipulations
- **Later:**
  - movements, manual therapies, stabilization  
(level 2 – e.g. Schneider et al CJSM 2012 22:295)



# VESTIBULAR REHAB

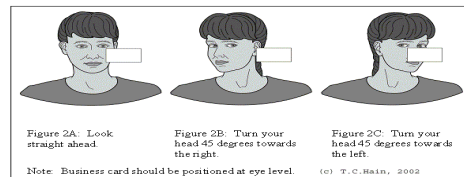
- Small number (1-3%?) of concussions involve **traumatic paroxysmal positional vertigo (PPV)**
- Well treated by **“vestibular rehab”**
  - canalith re-positioning manoeuvres
  - related balance control, gaze stabilization exercises



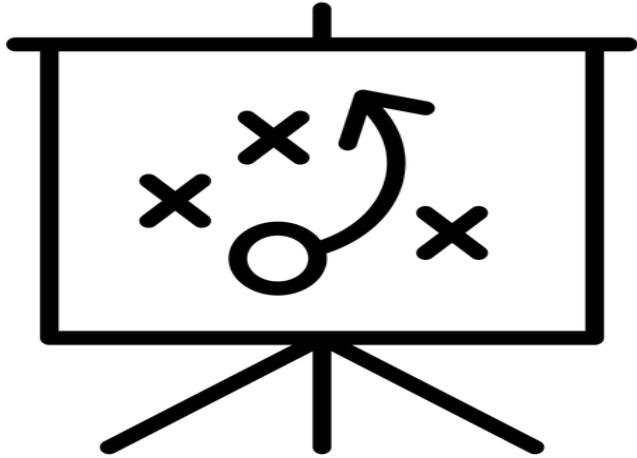


# BALANCE CONTROL REHAB

- Sometimes included under the umbrella of “vestibular” rehab
- **Multi-modal programs** address all aspects (sensory inputs, controller, motor outputs) of the balance control system
  - visual tracking / convergence exercises
  - gradual progression of head movements
  - standing balance exercises (eyes open, closed)
  - neck rehab – stabilization, manual, movement
- Emerging evidence for overall approach (components not sep'd)
  - Schneider et al CJSM 2012
  - Hugentobler et al IJSPT 2015



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3. Discuss the rationale and possible strategies for exercise as an intervention for those with persistent symptoms.





**THANK  
YOU**



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