

THE STATE OF THE HEAD



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PATHOPHYSIOLOGY

Disturbance of brain function is related to dysfunction of brain metabolism rather than a structural brain injury.

- Concussion, or mild traumatic brain injury, is caused by a direct blow to the head or indirect blow to another part of the body.
- The brain is made up of many cells (also called neurons) and when it shakes hard enough it negatively impacts all of those neurons.
 - Chemical exchange leads to toxic environment throughout the brain which makes it hard for the cells to communicate and also results in constriction of blood vessels.
 - Decrease in blood flow – energy supply is reduced
- The brain quickly starts to heal itself, though this takes time and energy at a time when the energy supply is reduced.

WHAT DOES THAT MEAN?

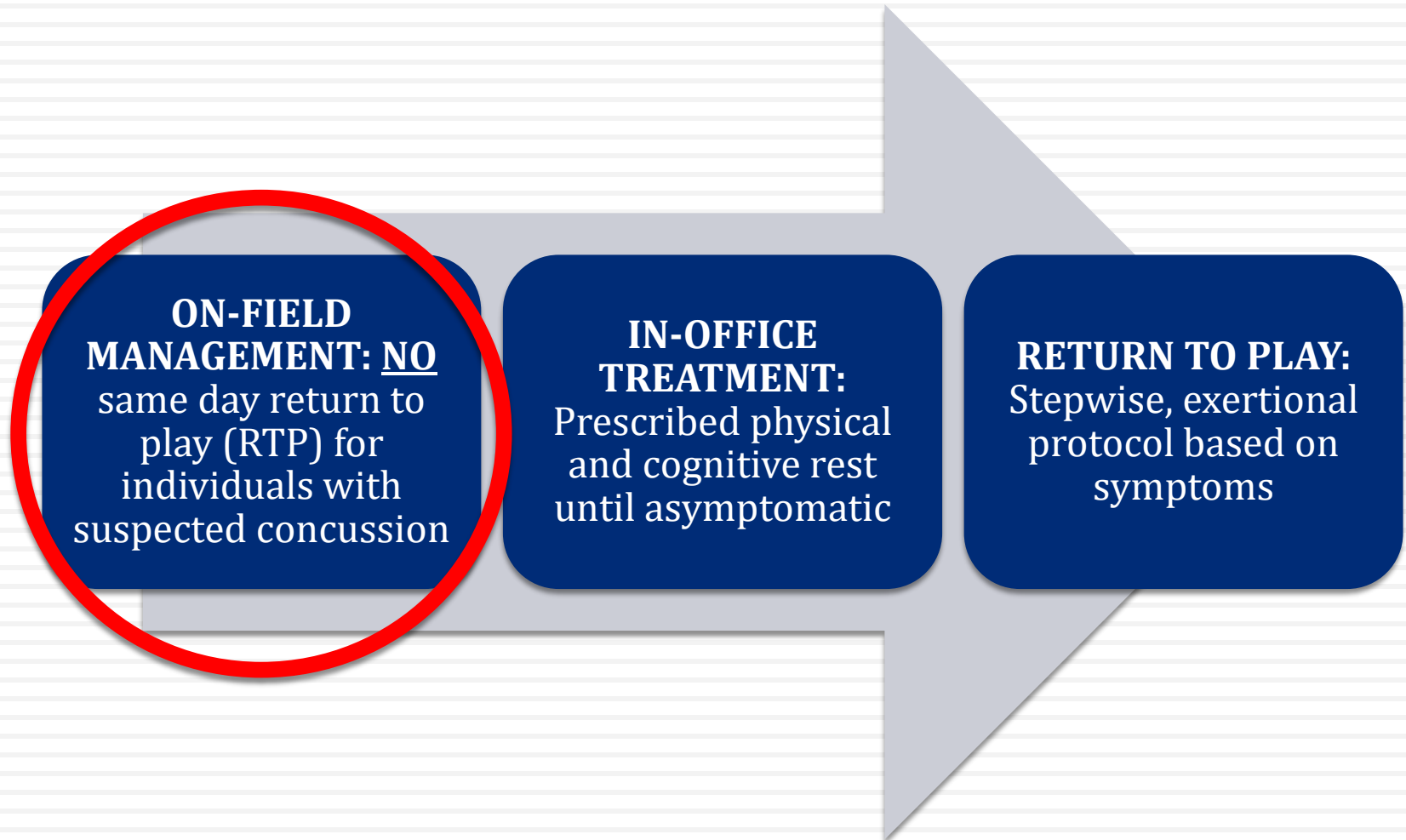


- There is an ENERGY CRISIS in the brain
 - Brain is working less efficiently
- There is NOT bleeding, swelling or bruising as commonly thought
- Therefore, no imaging or special tests are going to definitively show concussion

CONCUSSION RECOGNITION



THE “MILE HIGH” VIEW OF CONCUSSION TREATMENT



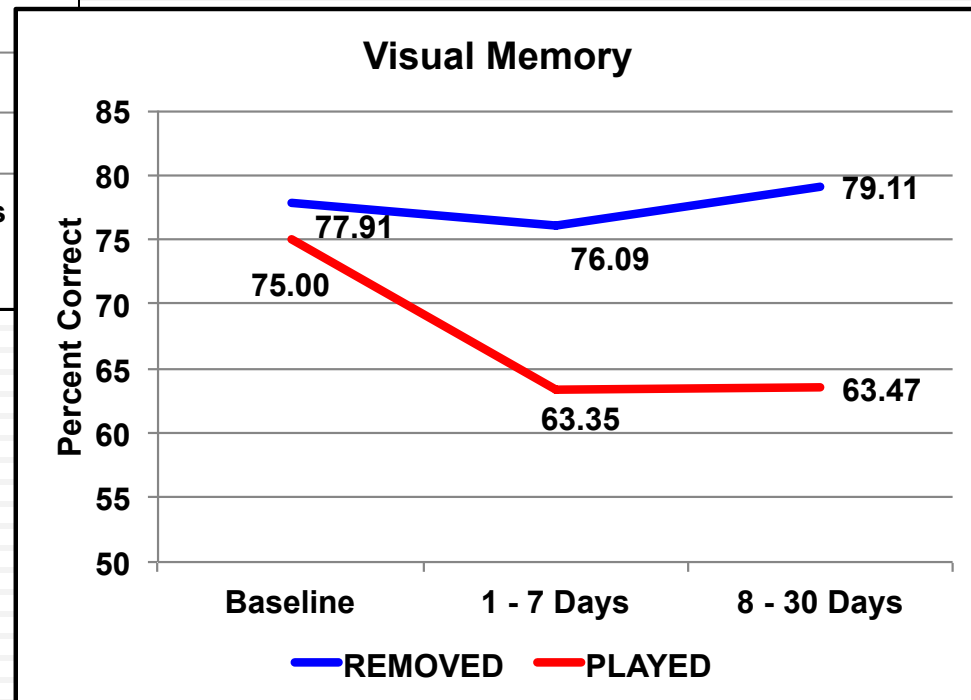
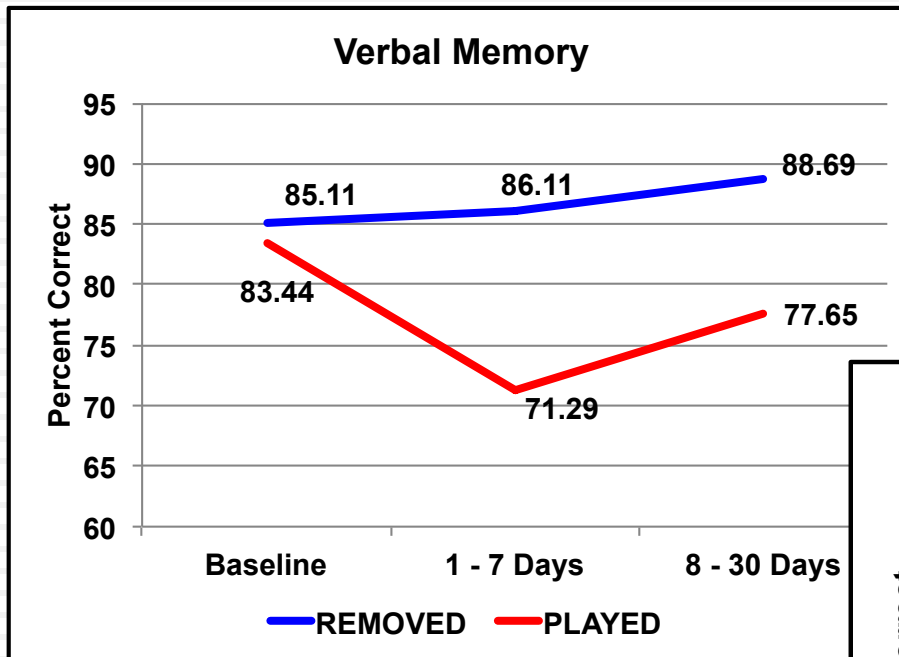
UNTIL RECENTLY, THERE WERE NO DATA TO SUPPORT THIS APPROACH

WHAT HAPPENS IF ATHLETES CONTINUE TO PLAY FOLLOWING CONCUSSION?

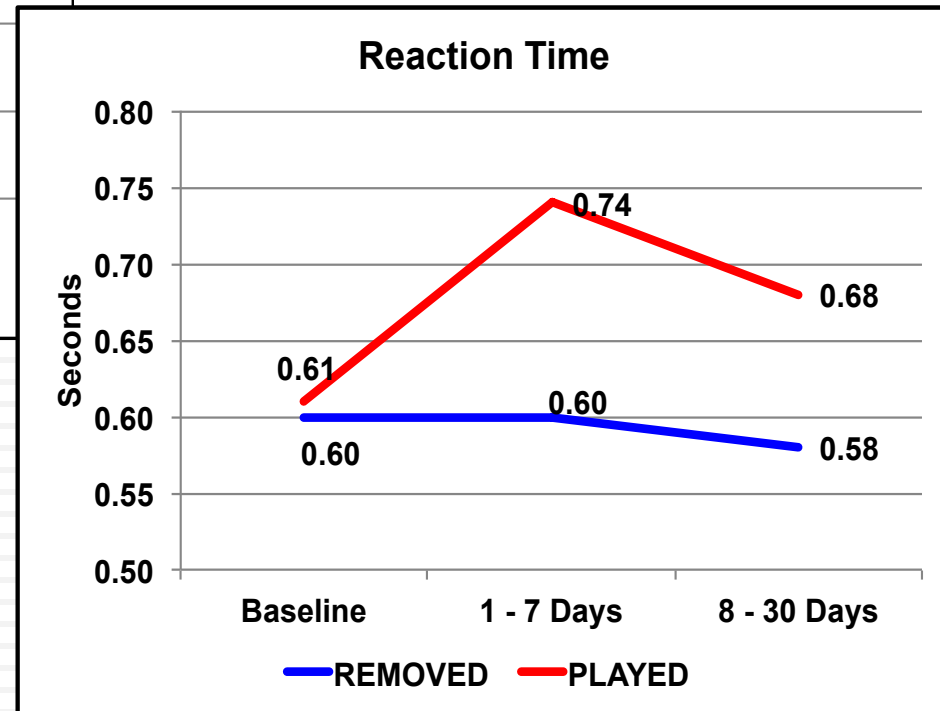
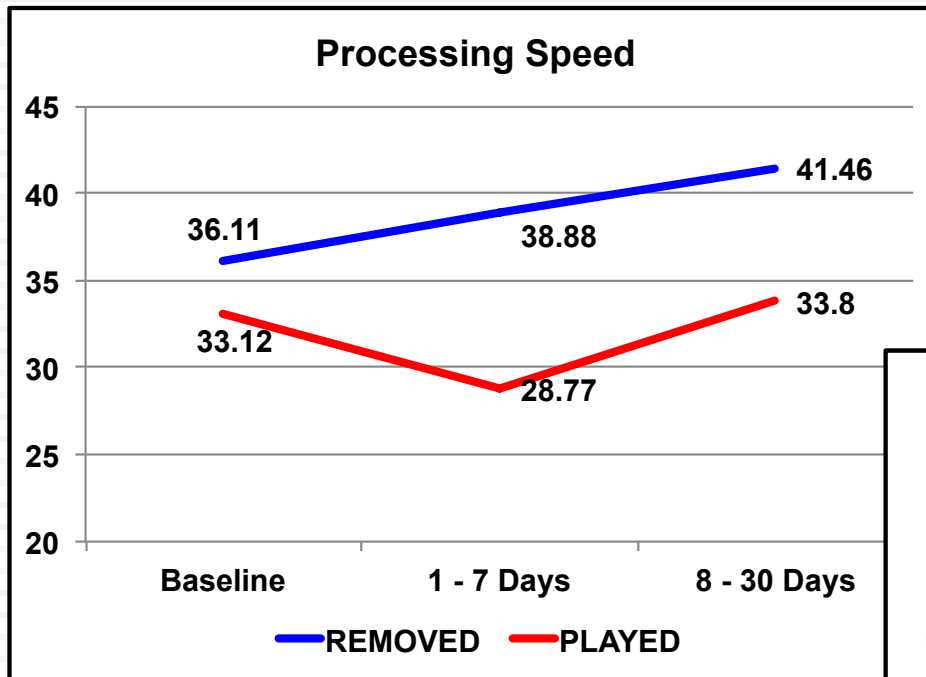


Elbin RJ, Sufrinko A, Schatz P, French J, Henry L, Burkhardt S, Collins MW, Kontos AP. *Peds.* 2016

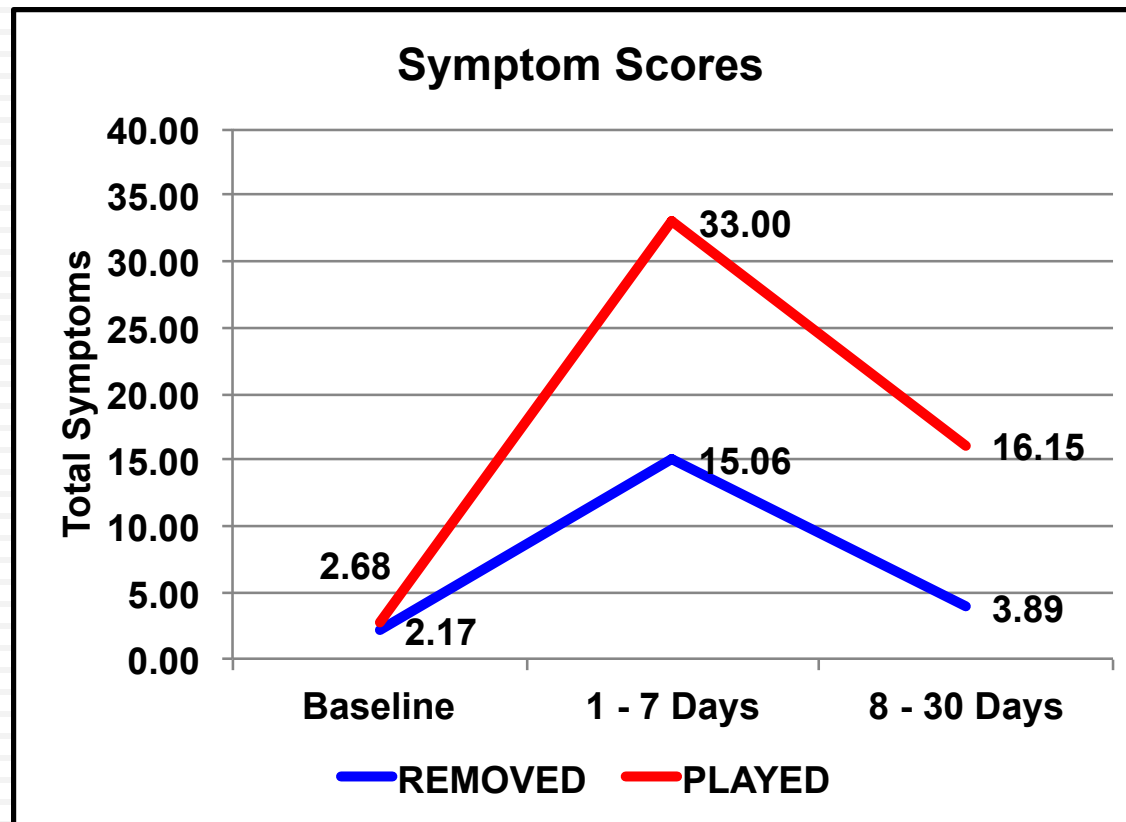
RESULTS



RESULTS



RESULTS



CONTINUING TO PLAY DOUBLED RECOVERY TIME

	REMOVED (<i>n</i> = 32)	PLAYED (<i>n</i> = 30)
Recovery Time*	21.97 ± 18.68 Days Range: 8 – 88	44.37 ± 36.03 Days Range: 10 - 164

**p* = .001

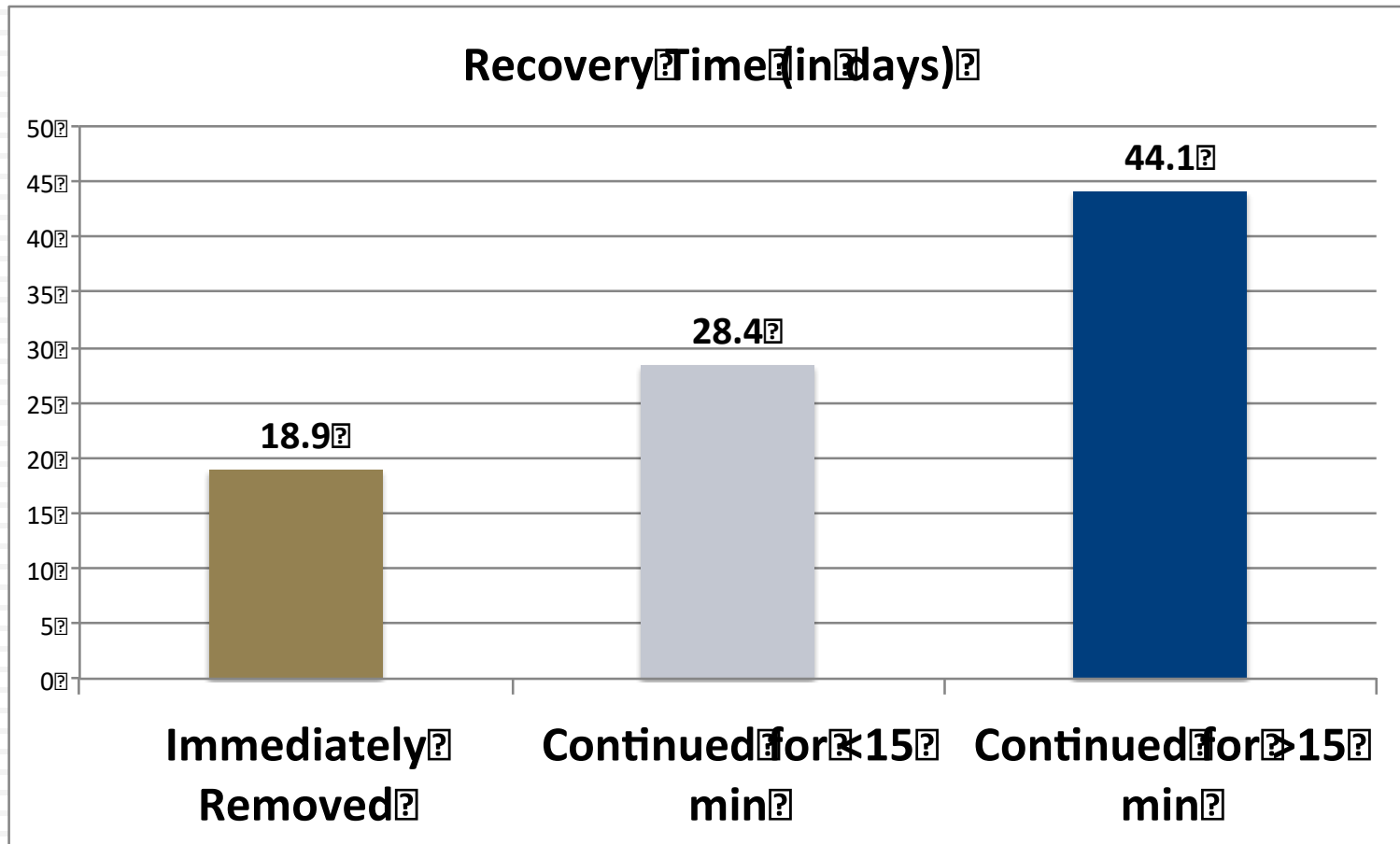
Athletes that continued to PLAY with a concussion were
8.80 times more likely to have prolonged recovery
≥ 21 days ($\chi^2 = 14.86$, $p < .001$)



UPDATE: IS THERE A “DOSE- RESPONSE” FOR LONGER RECOVERY IN ATHLETES WHO CONTINUE TO PLAY FOLLOWING A CONCUSSION?

Charek DB, Elbin RJ, Sufrinko A, Schatz P, D’Amico NR, Collins MW, Kontos AP. *J Head Trauma Rehabil.* 2020.

EVIDENCE FOR A DOSE-RESPONSE FOR CONTINUING TO PLAY FOLLOWING CONCUSSION



Continuing to play even for a few minutes extends recovery time.

SUMMARY

- Continuing to play was associated with worse:
 - ▣ Memory, Reaction Time, Symptoms
- Athletes who “stay in the game” with a concussion take twice as long to recover
- Continuing for just a few minutes can have adverse effects on recovery time.

SIDELINE EVALUATION: ADDITIONAL COMPONENTS

**IN ALL SUSPECTED
CASES OF
CONCUSSION, THE
INDIVIDUAL SHOULD
BE REMOVED FROM
THE PLAYING FIELD
AND ASSESSED BY A
PHYSICIAN OR
LICENSED HEALTH
CARE PROVIDER.**



- THERE IS NO PERFECT DIAGNOSTIC TEST OR MARKER FOR IMMEDIATE DIAGNOSIS IN THE SPORTING ENVIRONMENT
- **RESEARCH WOULD SUGGEST THAT A SIDELINE EVALUATION SHOULD INCLUDE A COMBINATION OF:**
 - Cognitive Screening
 - Balance Testing
 - Neurological Examination
 - Cranial Nerve Testing
 - Evaluation of Motor-Sensory Function
 - Vestibular/Ocular-Motor Assessment
 - Exertion Testing (if assessment appears normal, but concussion is still suspected)

SIDELINE EVALUATION: ADDITIONAL COMPONENTS

AVAILABLE TOOLS:

- ❑ SCAT5/CHILD SCAT5
 1. Immediate or on-field assessment
 2. Symptom Evaluation
 3. Cognitive Screening
 4. Neurological Screen
 5. Delayed Recall
 6. Decision
- ❑ BESS

SCAT5® SPORT CONCUSSION ASSESSMENT TOOL – 5TH EDITION
DEVELOPED BY THE CONCUSSION IN SPORT GROUP
FOR USE BY MEDICAL PROFESSIONALS ONLY

supported by



Child SCAT5® SPORT CONCUSSION ASSESSMENT TOOL
FOR CHILDREN AGES 5 TO 12 YEARS
FOR USE BY MEDICAL PROFESSIONALS ONLY

supported by



OTHER TOOLS BEING STUDIED FOR SIDELINE USE:

- ❑ VOMS
- ❑ King Devick
- ❑ and MANY others....(**REMEMBER:** Review the Research Evidence and Be Comprehensive)

NEED FOR EMERGENCY CARE

THE PURPOSE OF ACUTE CARE (I.E., EMERGENCY ROOM) FOLLOWING A CONCUSSION IS TO RULE OUT MORE SERIOUS INTRACRANIAL PATHOLOGY.

□ IDENTIFYING WHEN ACUTE CARE IS NEEDED:

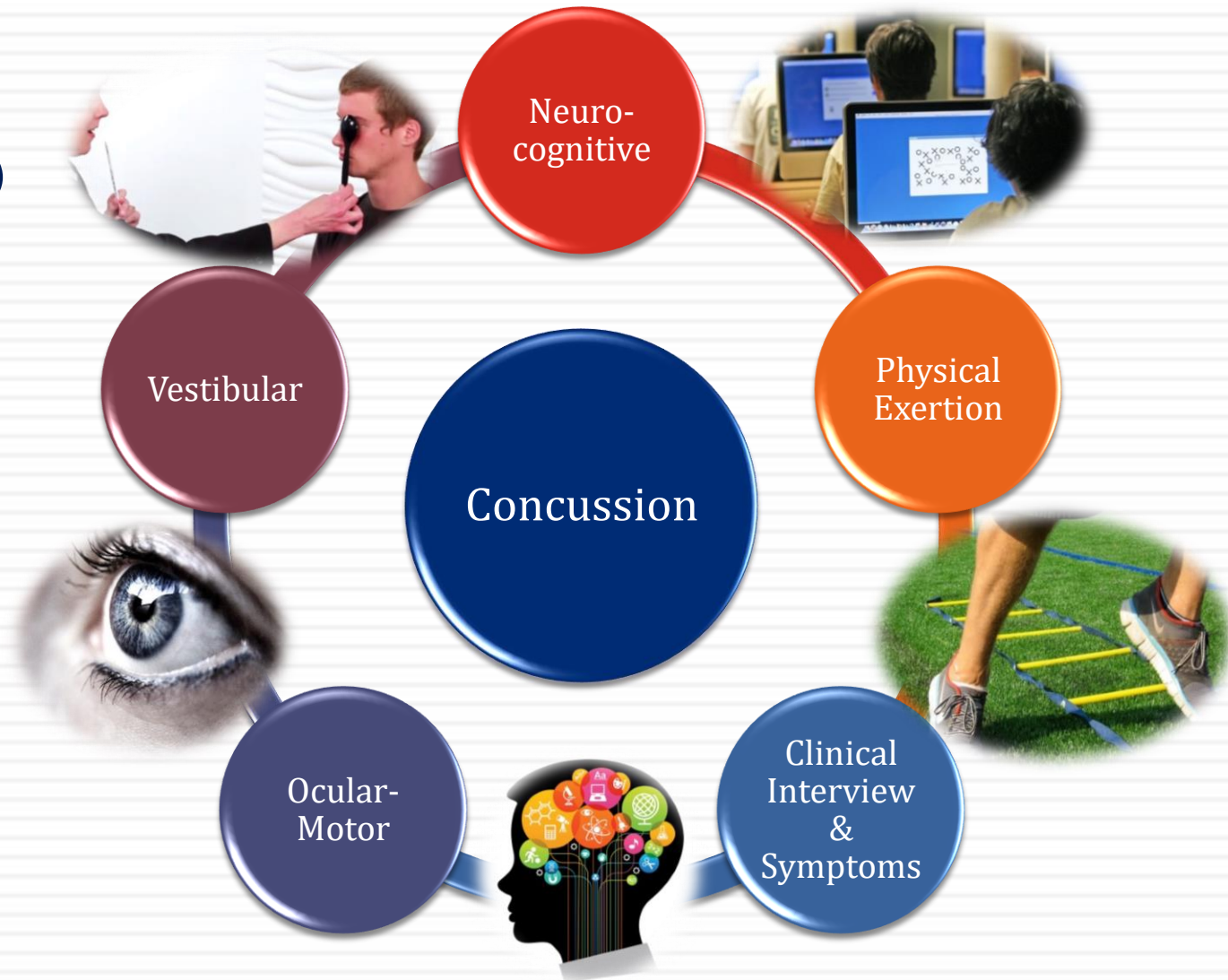
- ▣ HEADACHES THAT ARE SEVERE AND APPEAR TO BE WORSENING
- ▣ LOSS OF CONSCIOUSNESS
- ▣ SEIZURES
- ▣ VOMITING
- ▣ SLURRED SPEECH
- ▣ DISORIENTATION
- ▣ SIGNIFICANT BEHAVIORAL CHANGES
- ▣ WEAKNESS, NUMBNESS OR TINGLING IN THE EXTREMITIES
- ▣ CONCERNS REGARDING A CERVICAL INJURY
- ▣ ANY FOCAL NEUROLOGICAL SIGN



COMPREHENSIVE CLINICAL ASSESSMENT

□ Goals

- Establish diagnosis and prognosis
- Provide Education and Assure patients they will get better
- Identify clinical profile(s) involved
- Establish treatment and rehabilitation plan



SIGNS & SYMPTOMS

CONCUSSION SIGNS

Loss of Consciousness (LOC)
Slow to Get Up
Motor Incoordination/Balance
Problems
Blank/Vacant Look
Disorientation
Clutching Head

Physical

Headache
Nausea
Vomiting
Balance Problems
Dizziness
Visual problems
Light/Noise Sensitivity
Tinnitus

Emotional

Irritability
Sadness
Feeling “on-edge”
Nervousness
Anxiety
Rumination
Depression

CONCUSSION SYMPTOMS

Cognitive

Feeling slowed down
Feeling mentally foggy
Difficulty concentrating
Difficulty remembering
Amnesia

Sleep

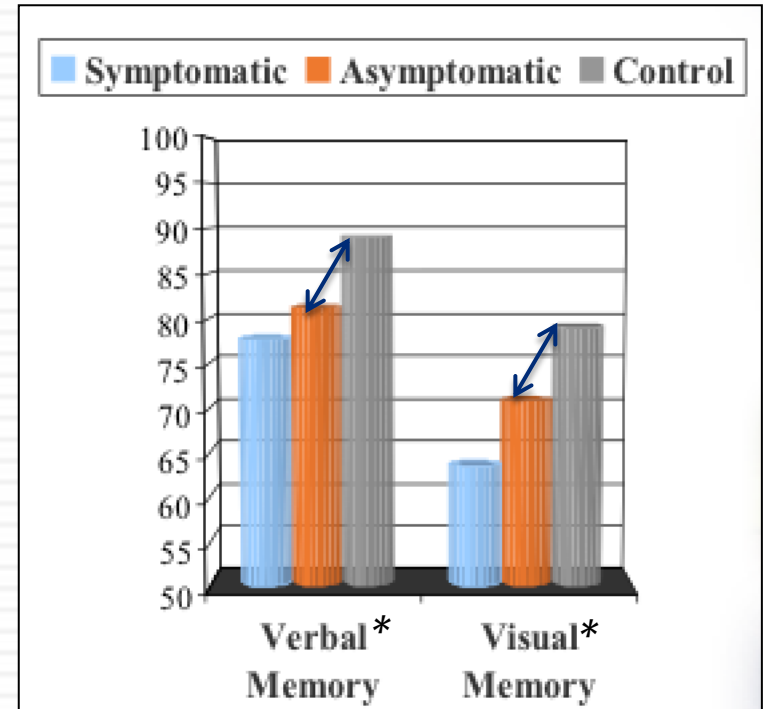
Trouble falling asleep
Sleeping more than normal
Sleeping less than normal
Fatigue/Drowsiness

WHAT IS NEUROCOGNITIVE TESTING?

- ❑ Neuropsychology is a branch of psychology with a focus on how injuries or illnesses of the brain affect cognitive functions and behaviors.
- ❑ Computerized neurocognitive and/or neuropsychological testing has roots in traditional batteries
- ❑ Concussion has been found to have the following effects
 - ▣ Impaired memory/learning
 - ▣ Reduced attention and ability to process information
 - ▣ Slowed RT
- ❑ Limitations
 - ▣ Effort
 - ▣ Motivation

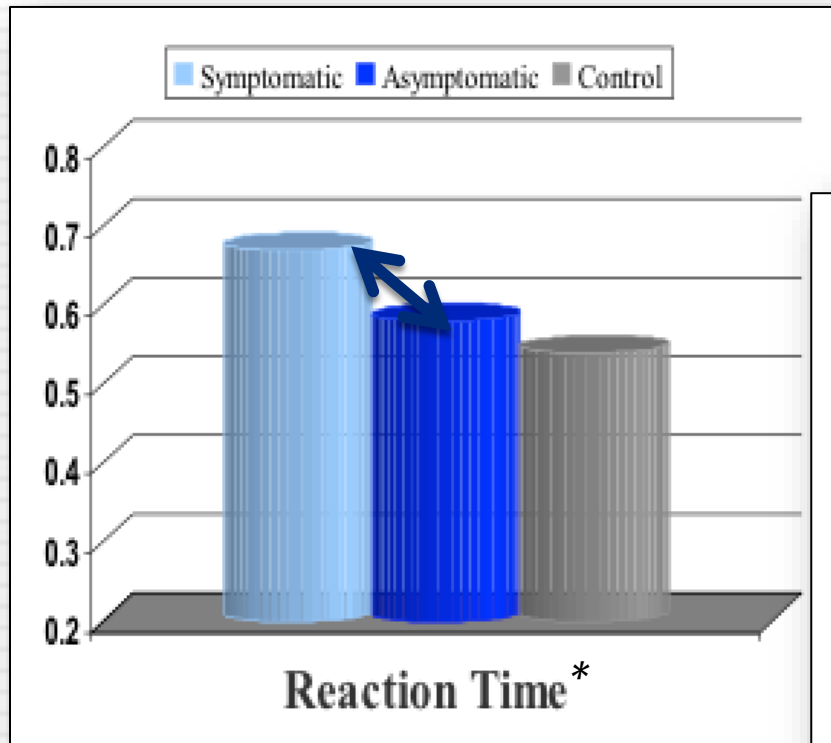
NEUROCOGNITIVE ASSESSMENT BENEFITS

- Testing reveals cognitive deficits in ASYMPTOMATIC athletes w/in 4 days of concussion
 - ▣ Supports the need for more objective assessment!

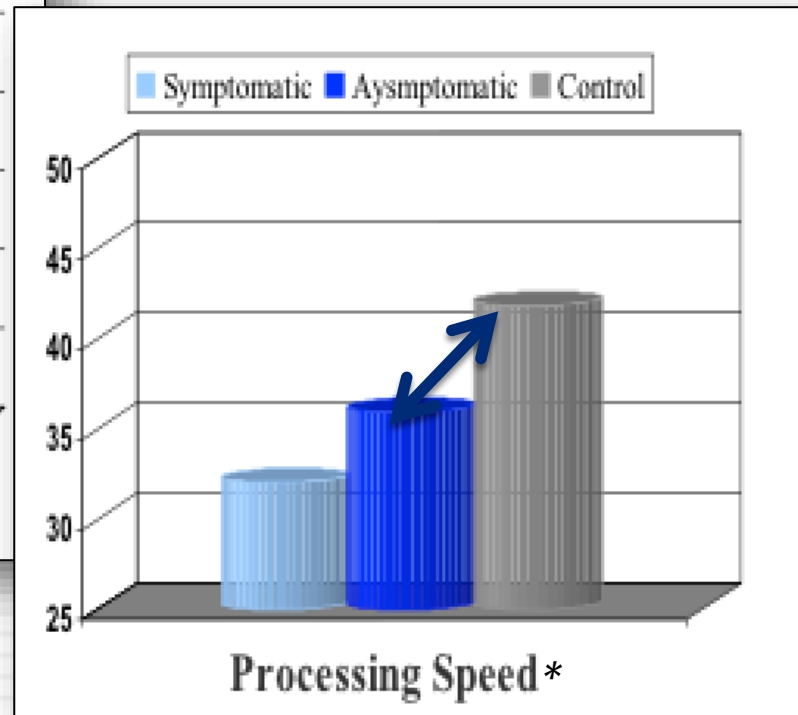


* $p \leq .001$

NEUROCOGNITIVE ASSESSMENT BENEFITS



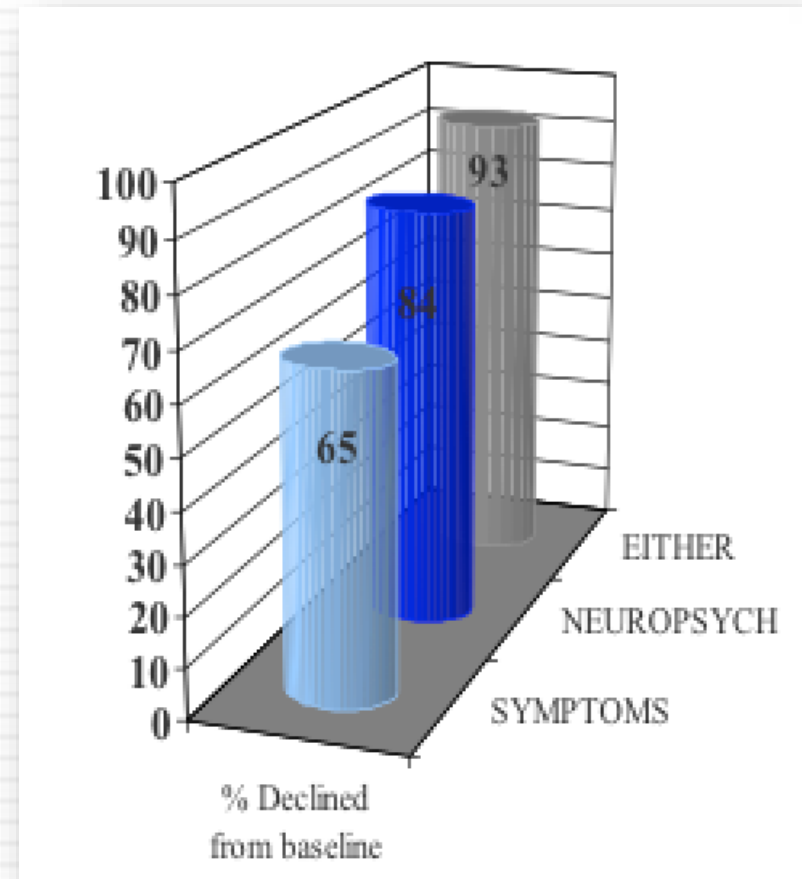
* $p \leq .001$



* $p \leq .001$

NEUROCOGNITIVE ASSESSMENT BENEFITS

- Increase diagnostic yield of 93%
- HS athletes (N = 201) tested w/in 2-days of injury
- Abnormal performance determined by RCI's



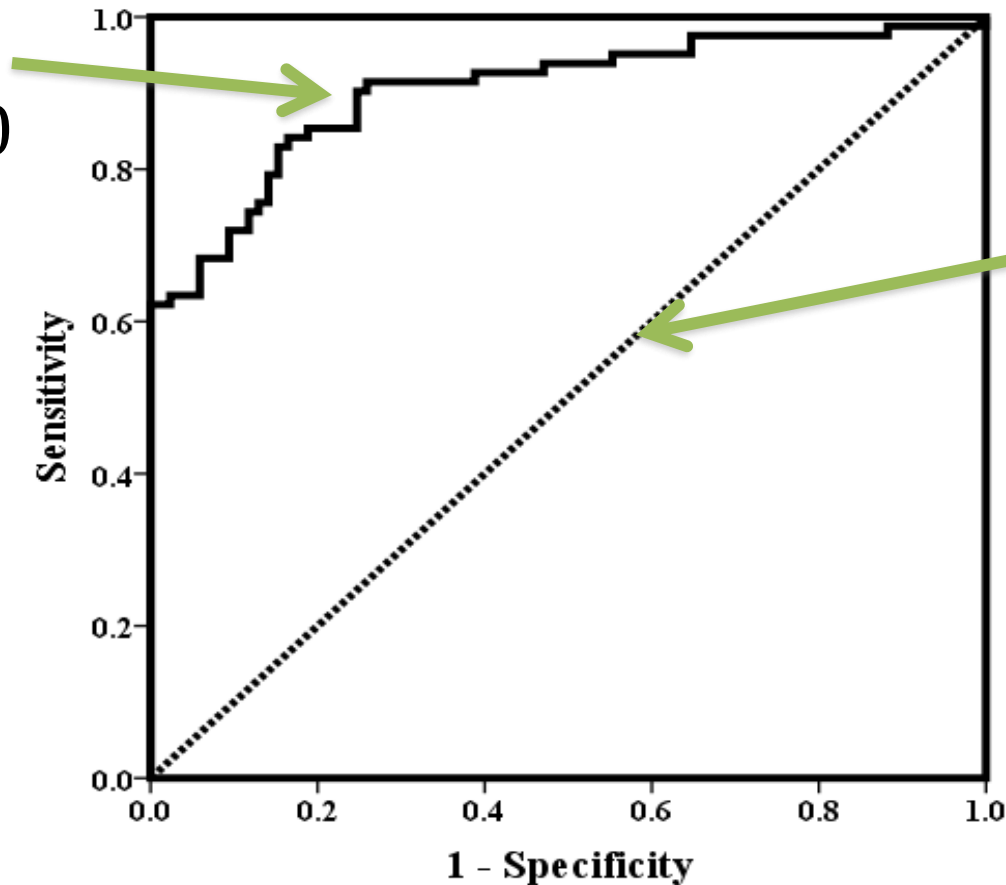
UPMC Vestibular/Ocular-Motor Screening (VOMS) for Concussion

Vestibular/Ocular Motor Test:	Not Tested	Headache 0-10	Dizziness 0-10	Nausea 0-10	Fogginess 0-10	Comments
BASELINE SYMPTOMS:	N/A					
Smooth Pursuits						
Saccades – Horizontal						
Saccades – Vertical						
Convergence (Near Point)						(Near Point in cm): Measure 1: _____ Measure 2: _____ Measure 3: _____
VOR – Horizontal						
VOR – Vertical						
Visual Motion Sensitivity Test						

Symptoms Reported By Patient on 0-10 Point Scale

VOMS ACCURACY

3 VOMS
Items=.90



Dotted line=.50
or no better than
chance

Receiver
Operating
Characteristic
Curve

Positive
Prediction
Rate of 90%

* Model variables: $\ln(\text{age})$, VOR, VMS and NPC distance, dotted line indicates AUC = 0.50

VOMS FOR CONTROLS

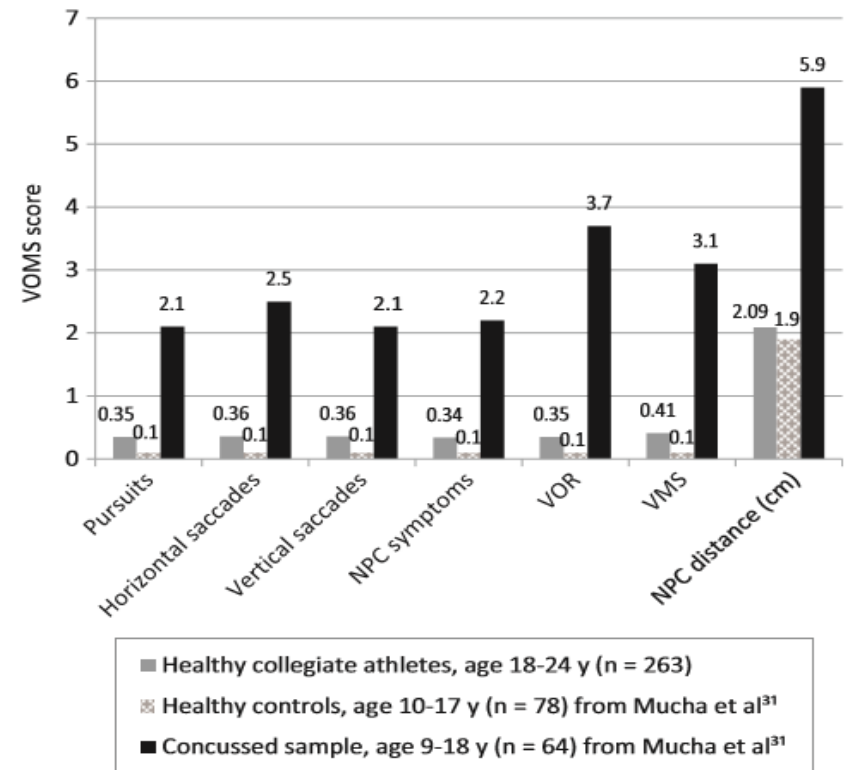
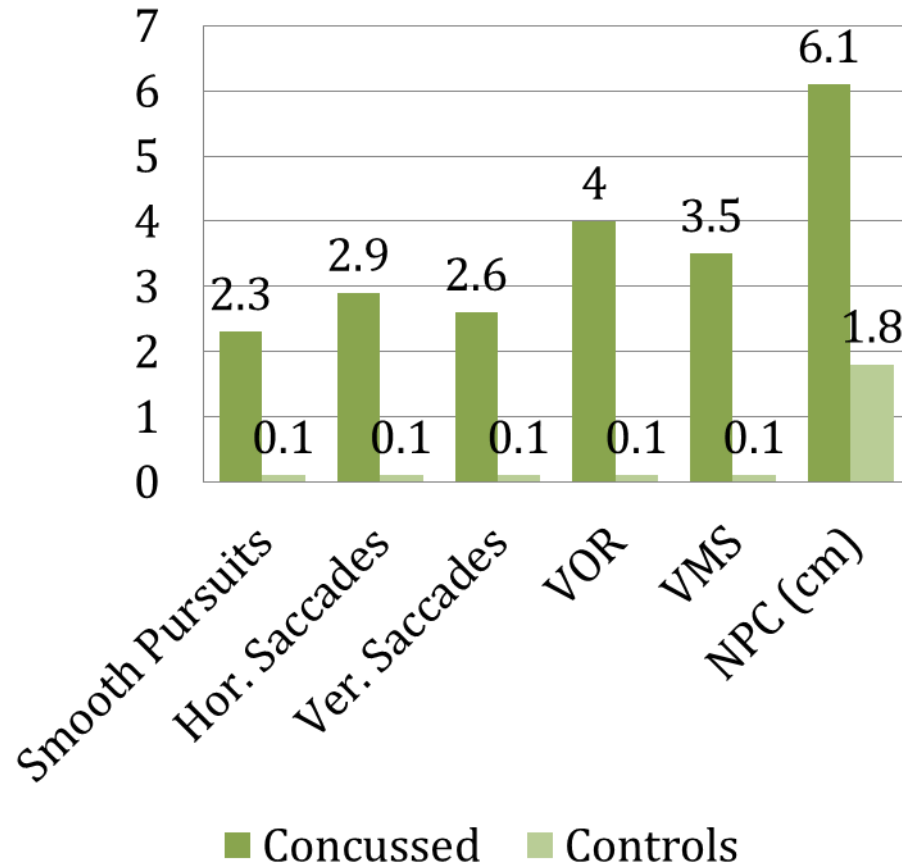
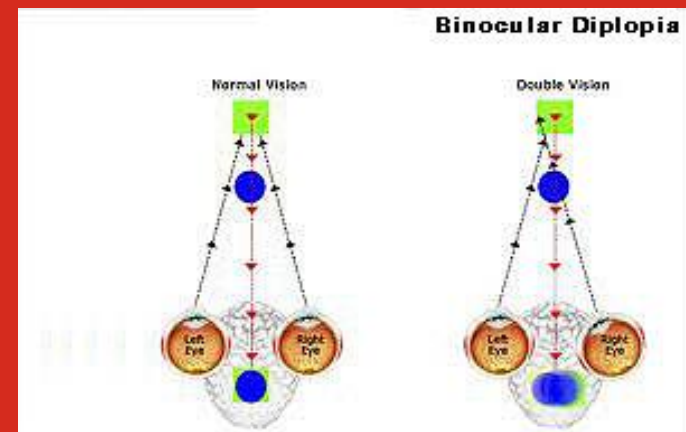
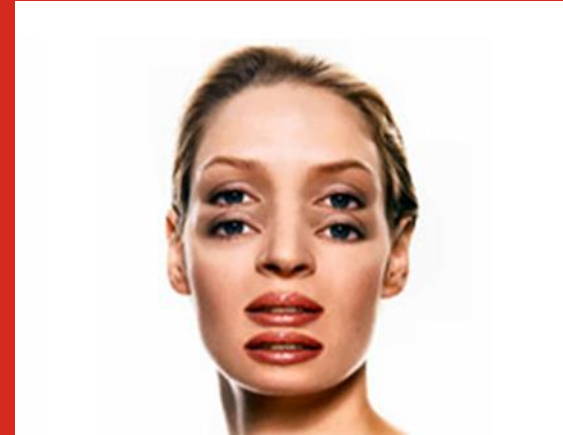


Figure 1. Mean Vestibular/Ocular Motor Screening (VOMS) scores for healthy collegiate athletes compared to previously published normative data (Mucha et al³¹) for concussed athletes. NPC, near point of convergence; VMS, visual motion sensitivity; VOR, vestibular ocular reflex.

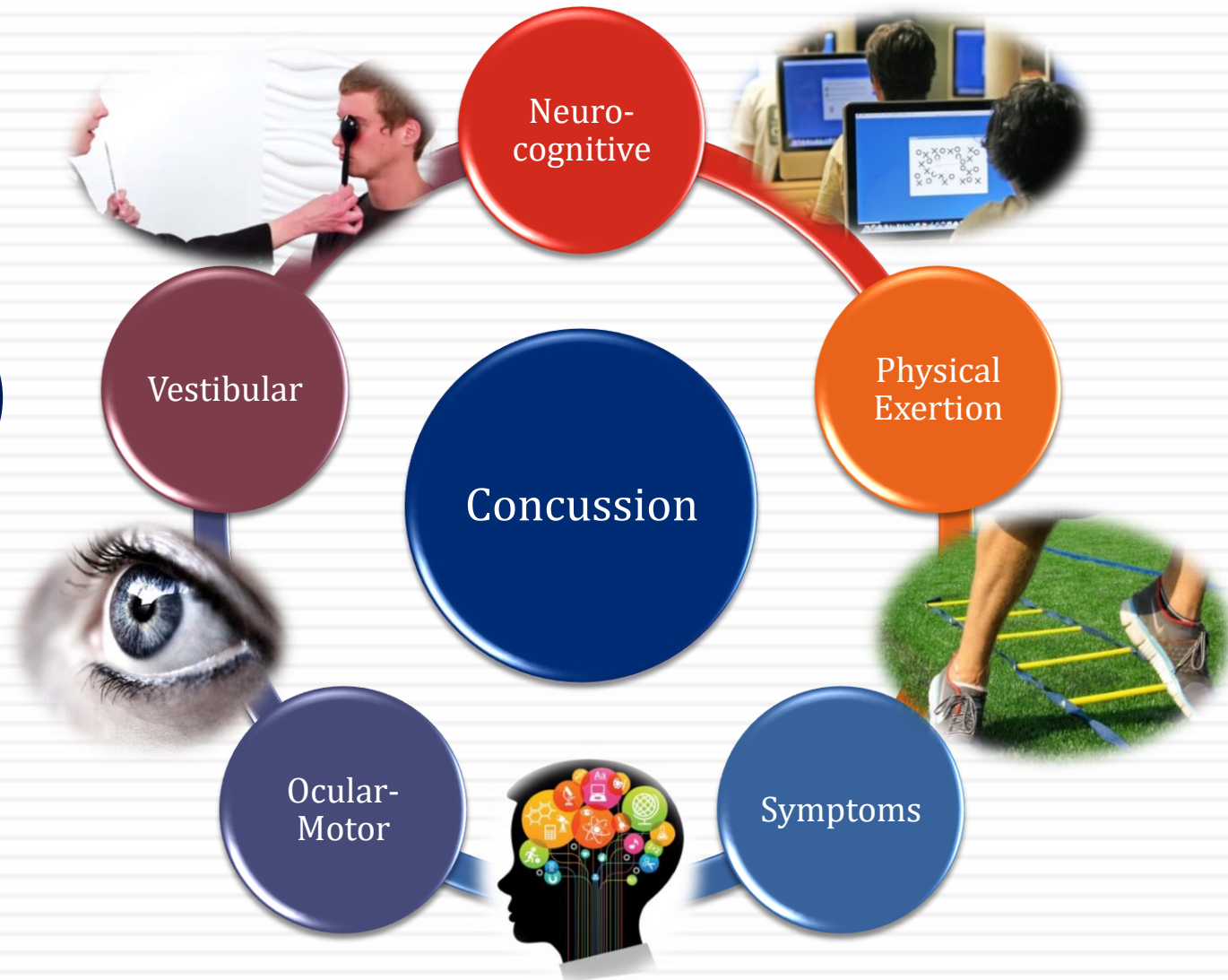
- Abnormal VOMS warrants referral to specialist
 - Concussion clinic for cognitive testing and medical management
 - Vestibular Rehabilitation
 - Balance
 - Gaze stability
 - Visual motion sensitivity
 - Mild convergence insufficiency
 - Behavioral optometrist or ophthalmologist
 - Blunt trauma
 - Vertical misalignments
 - Moderate/severe convergence insufficiency



COMPREHENSIVE CLINICAL ASSESSMENT

Goals

- Establish diagnosis and prognosis
- Provide Education and Assure patients they will get better
- Identify clinical profile(s) involved
- Establish treatment and rehabilitation plan



RECOVERY TIME IS LONGER THAN WE THOUGHT



Examining Recovery Trajectories Following Sport-related Concussion Using a Multi-Modal Clinical Assessment Approach

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Abstract

Background—Previous research estimates that the majority of athletes with sport-related concussion (SRC) will recover between 7–10 days following injury. This short, temporal window of recovery is predominately based on symptom resolution and cognitive improvement, and does not accurately reflect recent advances to the clinical assessment model.

Objective—To characterize SRC recovery at 1-week post-injury time intervals on symptom, neurocognitive, and vestibular-oculomotor outcomes, and examine gender differences on SRC recovery time.

Methods—A prospective, repeated measures design was used to examine the temporal resolution of neurocognitive, symptom, and vestibular-oculomotor impairment in 66 subjects (16.5 ± 1.9 years, range 14–23, 64% male) with SRC.

Results—Recovery time across all outcomes was between 21–28 days post SRC for most athletes. Symptoms demonstrated the greatest improvement in the first 2 weeks, while neurocognitive impairment lingered across various domains up to 28 days post SRC. Vestibular-oculomotor decrements also resolved between one to three weeks post injury. There were no gender differences in neurocognitive recovery. Males were more likely to be asymptomatic by the fourth week and reported less vestibular-oculomotor impairment than females at weeks 1 and 2.

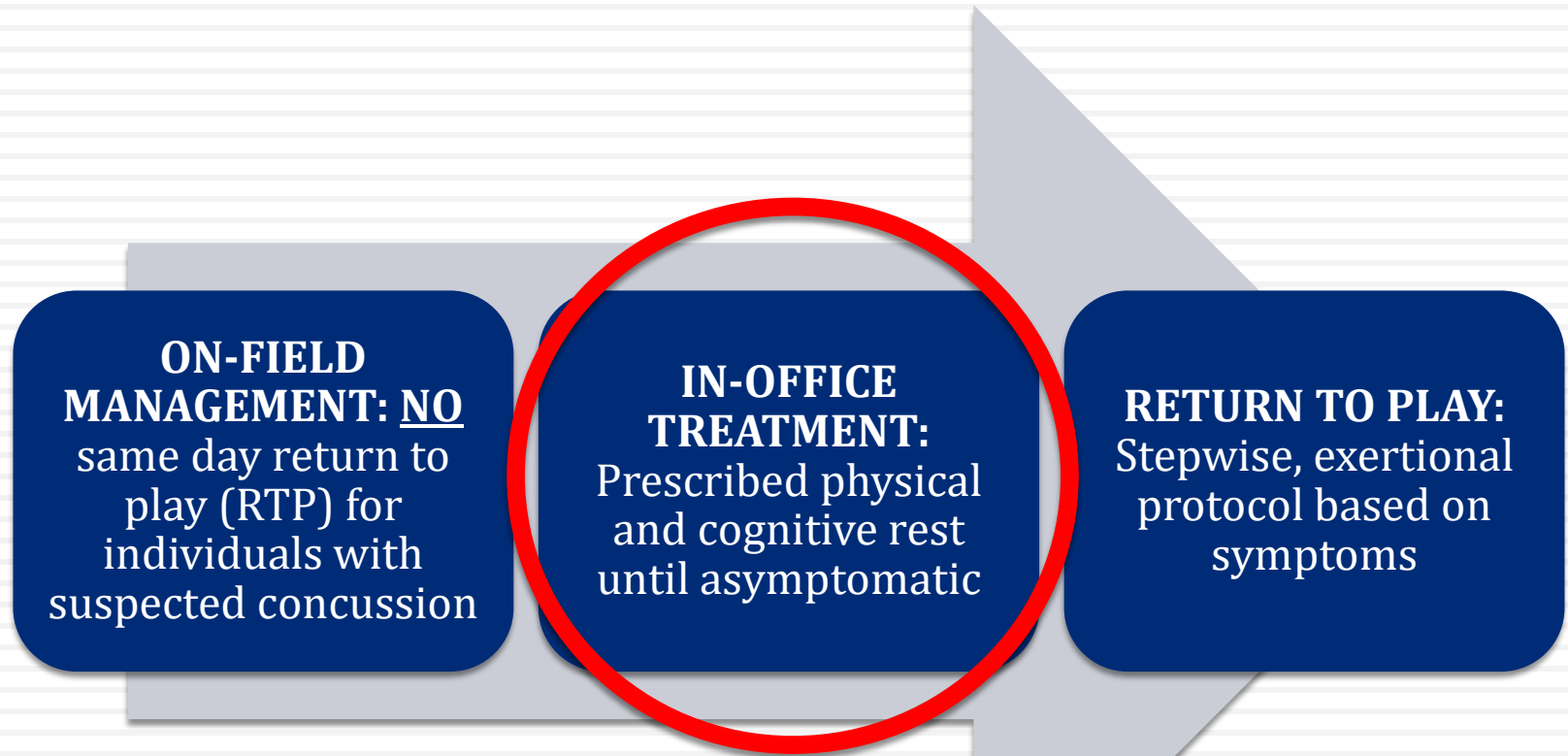
Conclusion—When utilizing the recommended “comprehensive” approach for concussion assessment, recovery time for SRC is approximately three to four weeks, which is longer than the commonly reported 7–14 days. Sports medicine clinicians should use a variety of complementing assessment tools to capture the heterogeneity of SRC.

SETTING EXPECTATIONS - SYMPTOMS

- ❑ SYMPTOMS WILL VARY IN INTENSITY AND PRESENTATION BASED ON THE INDIVIDUAL AND THE SEVERITY OF THE CONCUSSION.
- ❑ PATIENTS MAY NOT LOOK OR EVEN ACT INJURED IMMEDIATELY AFTER THE INJURY.
- ❑ SYMPTOMS CAN WORSEN WITH COGNITIVE **AND/OR** PHYSICAL EXERTION.
- ❑ SYMPTOMS CAN WAX AND WANE THROUGHOUT THE DAY.



THE “MILE HIGH” VIEW OF CONCUSSION TREATMENT



REST HAS BEEN THE STANDARD OF CARE, BUT WITH LIMITED EVIDENCE

REST IS BEST...

(“IT’S THE ONLY THING WE HAVE!”)

“There is really nothing we can do for concussion.” “There really are **NO TREATMENTS** for this injury.”

“You need to **REST**.”

“**NO** physical or cognitive activity until your symptoms resolve.”

“Then we will gradually introduce activity (physical/cognitive).”



WHAT IS REST?

- Not well defined in studies (type, timing, dose, frequency?)
- Avoidance or mitigate exertion during physical and mental activities (e.g., sports, exercise, phone use, social, etc....)
- If some is good, more MUST be better?
 - No research that demonstrates using a cell phone or watching TV is detrimental (Halstead et al., 2017)

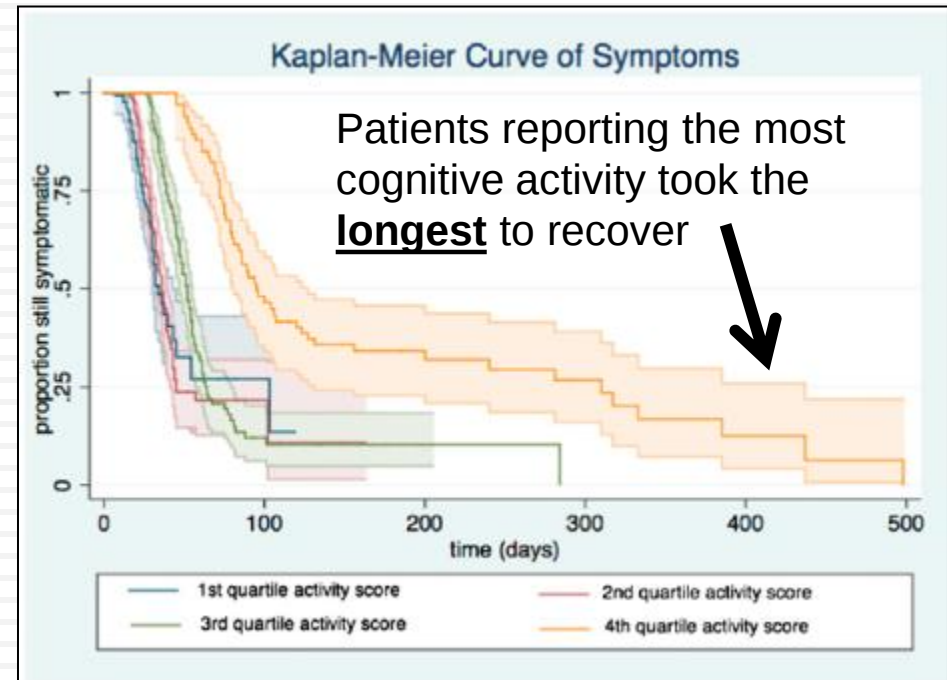
WHAT DO WE KNOW ABOUT REST AS A TREATMENT/INTERVENTION FOR CONCUSSION?

- ❑ Most consensus statements recommend rest until symptom free
 - ▣ Prescribed rest is one of the most common interventions for concussion
 - ▣ Treatments not mentioned

- ❑ Theory Behind Rest
 - ▣ Decreases “metabolic demand” on the brain
 - ▣ Mitigates symptoms
 - ▣ Avoids additional head impacts/injury

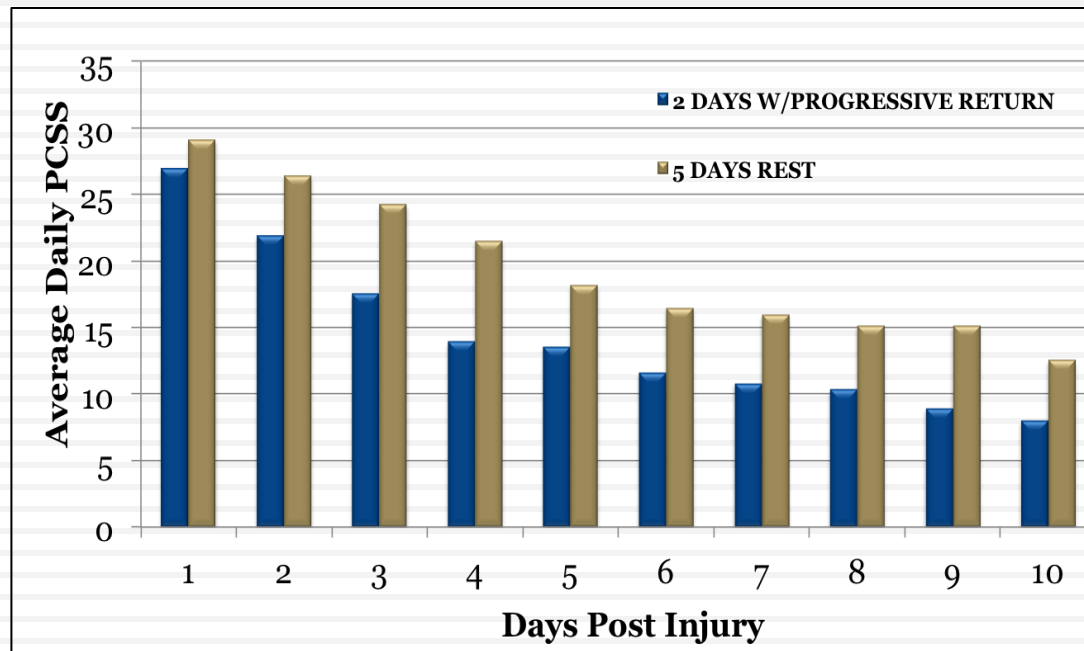
THE EVIDENCE SUPPORTING REST FOLLOWING CONCUSSION IS LIMITED

- A positive relationship between cognitive activity and recovery time ($N=335$; within 3 weeks of injury) (Brown et al., *Peds.* 2014)



- HS and college athletes ($N = 49$) prescribed at least 1 week of cognitive and physical rest showed improved neurocognitive performance and decreased symptoms (Moser et al., *J Pediatr.* 2012)

EMERGING STUDIES NOT SUPPORTING REST FOR CONCUSSION



5-DAY REST group = higher total symptoms during recovery than 2-DAY REST W/PROGRESSIVE RETURN

PATIENTS THAT WERE PRESCRIBED REST EXHIBITED LONGER SYMPTOMS

EMERGING STUDIES NOT SUPPORTING REST FOR CONCUSSION

- Athletes **NOT** provided any post-injury recommendations exhibited asymptomatic status and return to baseline on concussion assessments sooner than athletes prescribed cognitive and physical rest (Buckley et al., *J Head Trauma Rehabil.* 2016)
- Patients in later post-injury phases may benefit from **moderately** active rehabilitation (Majerske et al., *J Athl Train.* 2008)
 - ▣ Low and high levels of activity in the first month following injury had the worst outcomes

THERE IS A “SWEET SPOT” SOMEWHERE!

REST CAN BACKFIRE...

- Strict rest/Cocoon therapy is contraindicated...
 - Majority agreement in expert clinical consensus (Collins et al., 2016)
- Possible negative consequences of rest
 - Mood worsened through removal from routines, social isolation, missed school/sport (Olsson et al., 2013; Ponsford et al., 2012)
 - Hypervigilance = focus on symptoms (Heath, 2013)
 - “Somaticizers” (Root et al., 2016)
 - Discharge instructions for rest = more symptoms (Zuckerbraun et al., 2014)
 - Contextual framing effect

CONCUSSION IN SPORT GROUP 2017 CONSENSUS

- ❑ Lack of evidence for **COMPLETE** rest
- ❑ After a brief period of rest (24-48 hrs.), we can allow activity/exertion below symptom thresholds
- ❑ Uses the term “treatment”

Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016

Paul McCrory,¹ Willem Meeuwisse,² Jiří Dvorak,^{3,4} Mark Aubry,⁵ Julian Bailes,⁶ Steven Broglio,⁷ Robert C Cantu,⁸ David Cassidy,⁹ Ruben J Echemendia,^{10,11} Rudy J Castellani,¹² Gavin A Davis,^{13,14} Richard Ellenbogen,¹⁵ Carolyn Emery,¹⁶ Lars Engebretsen,¹⁷ Nina Feddermann-Demont,^{18,19} Christopher C Giza,^{20,21} Kevin M Guskiewicz,²² Stanley Herring,²³ Grant L Iverson,²⁴ Karen M Johnston,²⁵ James Kissick,²⁶ Jeffrey Kutcher,²⁷ John J Leddy,²⁸ David Maddocks,²⁹ Michael Makdissi,^{30,31} Geoff T Manley,³² Michael McCrea,³³ William P Meehan,^{34,35} Sinji Nagahiro,³⁶ Jon Patricios,^{37,38} Margot Putukian,³⁹ Kathryn J Schneider,⁴⁰ Allen Sills,^{41,42} Charles H Tator,^{43,44} Michael Turner,⁴⁵ Pieter E Vos⁴⁶

STRICT/PROLONGED REST IN NOT BEST!

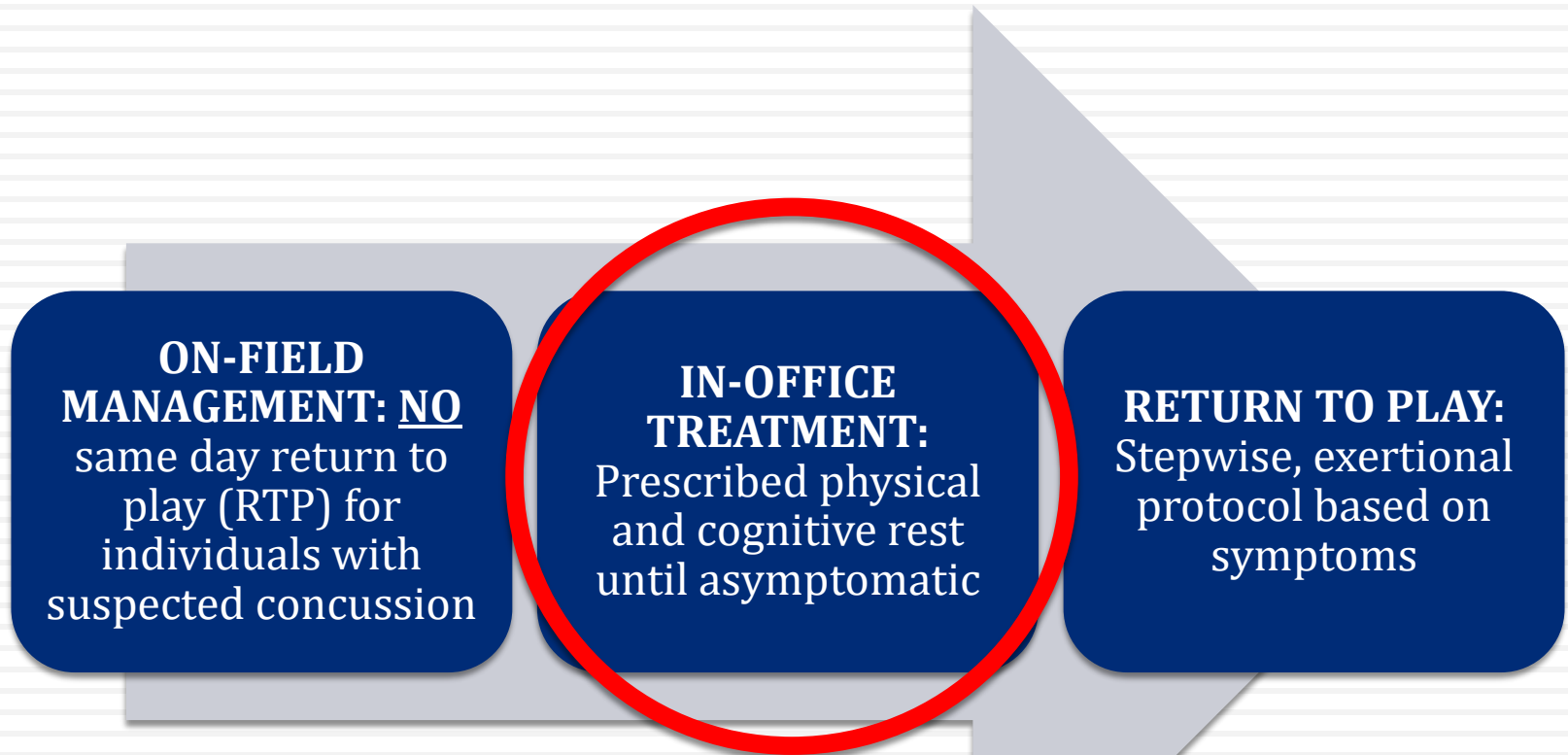


There is currently insufficient evidence that prescribing complete rest achieves these objectives. After a brief period of rest during the acute phase (24-48 hours) after injury, patients can be encouraged to become gradually and progressively more active while staying below their cognitive and physical symptom-exacerbation thresholds (i.e., activity level should not bring on or worsen their symptoms). It is reasonable for athletes to avoid vigorous exertion while they are recovering. The exact amount and duration of rest is not yet well defined in the literature and requires further study.

SUMMARY ON REST AS AN TREATMENT FOR CONCUSSION

- ❑ Research and clinical/expert consensus **NO** longer support the belief that resting in a quiet, dark room alone until symptoms resolve is best following a concussion
- ❑ An acute rest period (24-48 hrs.) is supported, then allow activity (McCrory et al., 2017)

THE “MILE HIGH” VIEW OF CONCUSSION TREATMENT



So, if prolonged rest is NOT our best option, then what ACTIVE treatments are there?

EMERGING TREATMENTS FOR CONCUSSION

□ Behavioral Regulation

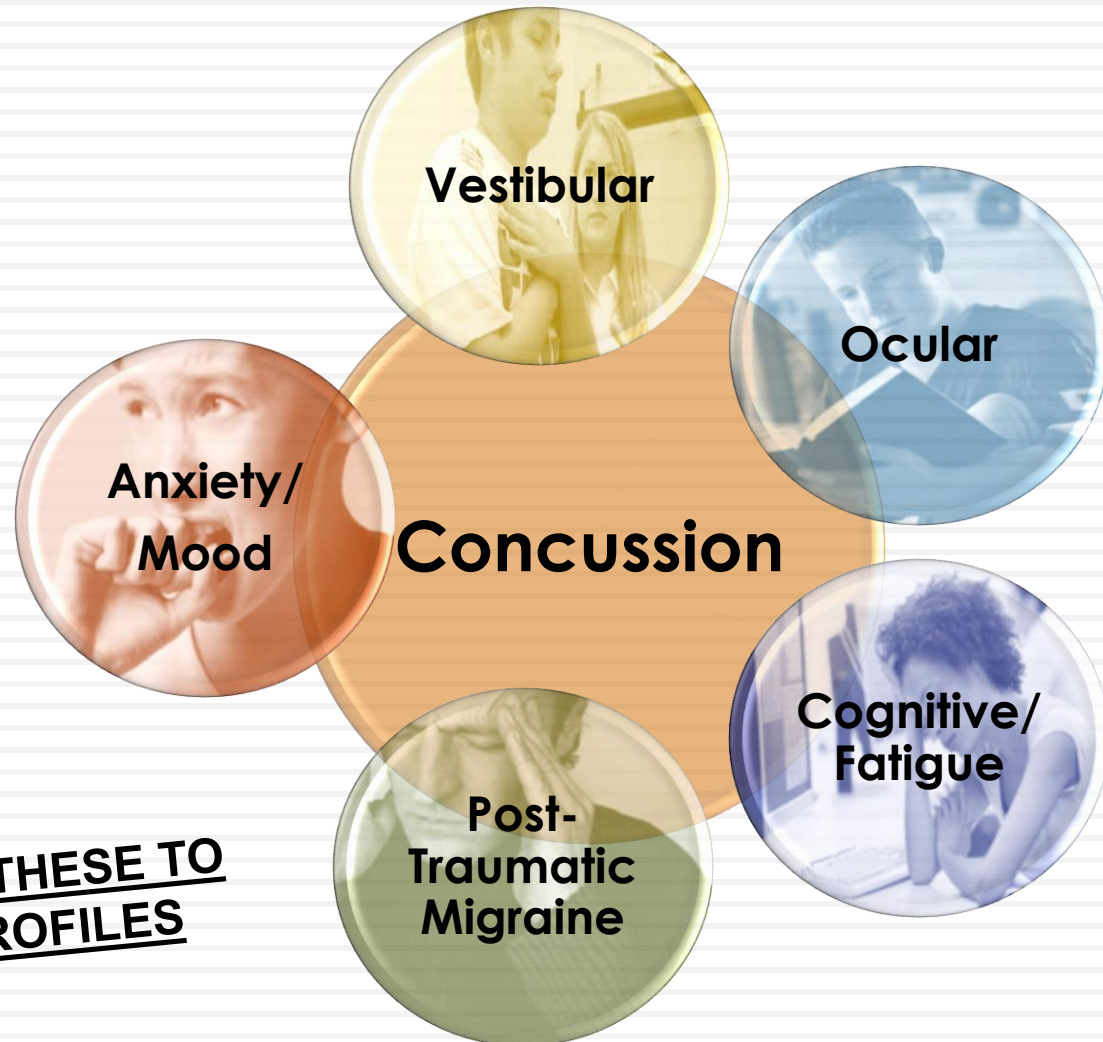
- ▣ Sleep
- ▣ Exercise
- ▣ Nutrition/Hydration
- ▣ Stress Management

□ Active Therapies/Rehab

- ▣ Vestibular therapy
- ▣ Oculomotor therapy
- ▣ Exertional therapy
- ▣ Psychotherapy

□ Pharmacological...

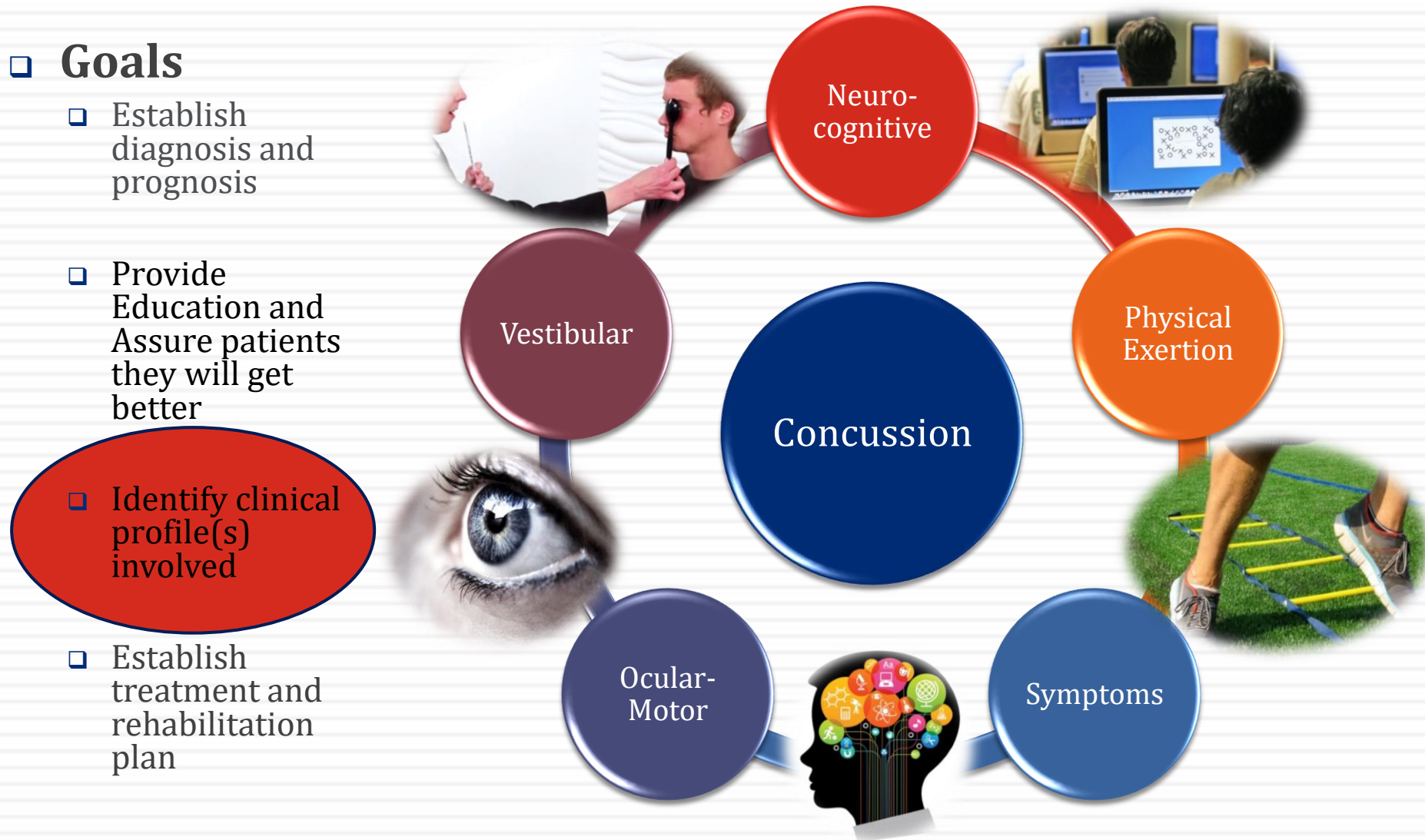
**IMPORTANT TO MATCH THESE TO
EMERGING CLINICAL PROFILES**



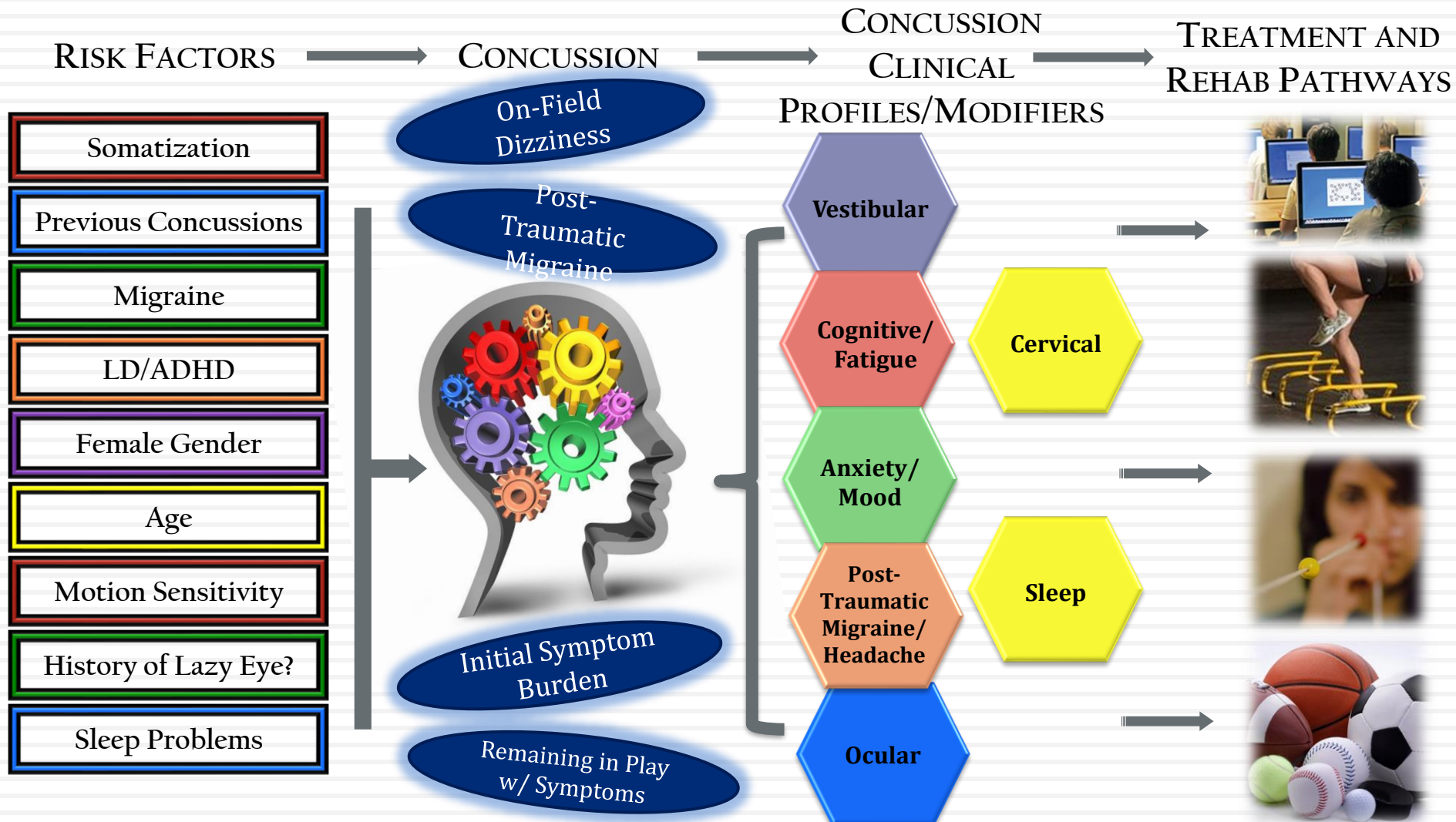
COMPREHENSIVE CLINICAL ASSESSMENT

□ Goals

- Establish diagnosis and prognosis
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CLINICAL PROFILES



Vestibular

Symptoms:

Trouble stabilizing vision when moving; slow wavy dizziness; balance problems

Treatment:

Vestibular therapy customized for patient's normal daily environments

Ocular-motor

Symptoms:

Difficulty coordinating eye movements; headache; fatigue; visual difficulties

Treatment:

Vision and/or vestibular therapy

Cognitive Fatigue

Symptoms:

Decreased ability to multitask; poor memory; fatigue; trouble learning

Treatment:

Accommodations; behavioral management; Medication

Post-traumatic Migraine

Symptoms:

Headache, nausea and sensitivity to light or noise

Treatment:

Behavioral management including physical activity; Medication

Anxiety/Mood

Symptoms:

Excessive anxiety, significant irritability, sad/depressed mood

Treatment:

Physical activity; medication; psychotherapy; relaxation strategies

Sleep

Symptoms:

Difficulty falling asleep, Difficulty staying asleep, Oversleeping, Under sleeping

Treatment:

Setting a sleep schedule, use of supplement, relaxation/sleep hygiene

Cervical

Symptoms:

Headaches and neck pain; Difficulty sleeping

Treatment:

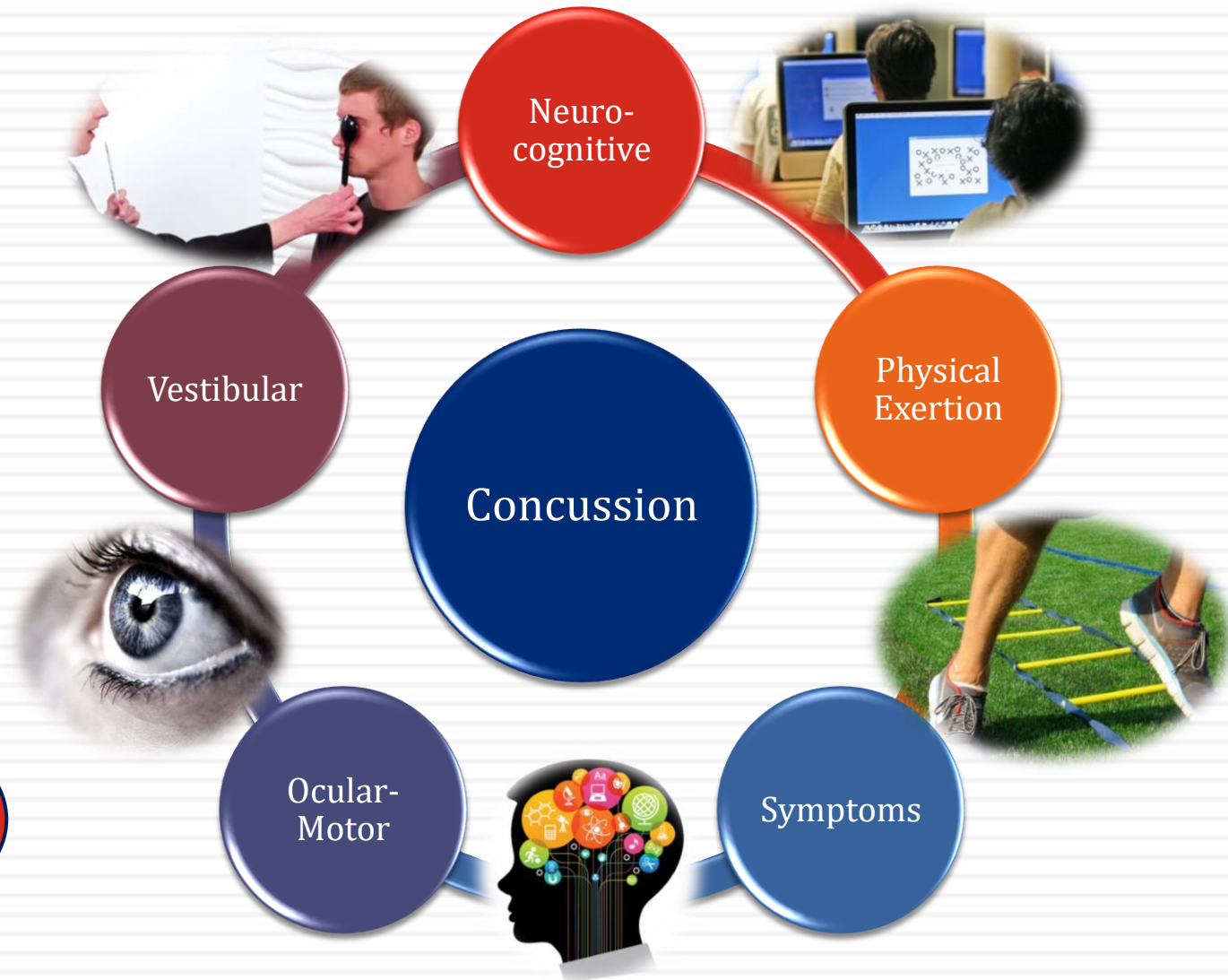
Cervical physical therapy; medication; at home stretching



COMPREHENSIVE CLINICAL ASSESSMENT

□ Goals

- Establish diagnosis and prognosis
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1. **DIET:** Eat breakfast, lunch and dinner each day.
2. **HYDRATION:** Stay well hydrated.
3. **SLEEP:** Stick to a strict sleep schedule with a regular bedtime and wake-up time. It is generally recommended that patients obtain 7-9 hours, with limited to no naps of no longer than 30 minutes.
4. **PHYSICAL ACTIVITY:** It is recommended that patients take walks or ride a stationary bike following the injury. Once they are seen by a physician additional recommendations can be made.
5. **STRESS:** Try to reduce stress in the individual. Reduced focus on the injury can help to avoid nervousness and increased anxiety.

BEHAVIORAL MANAGEMENT STRATEGIES

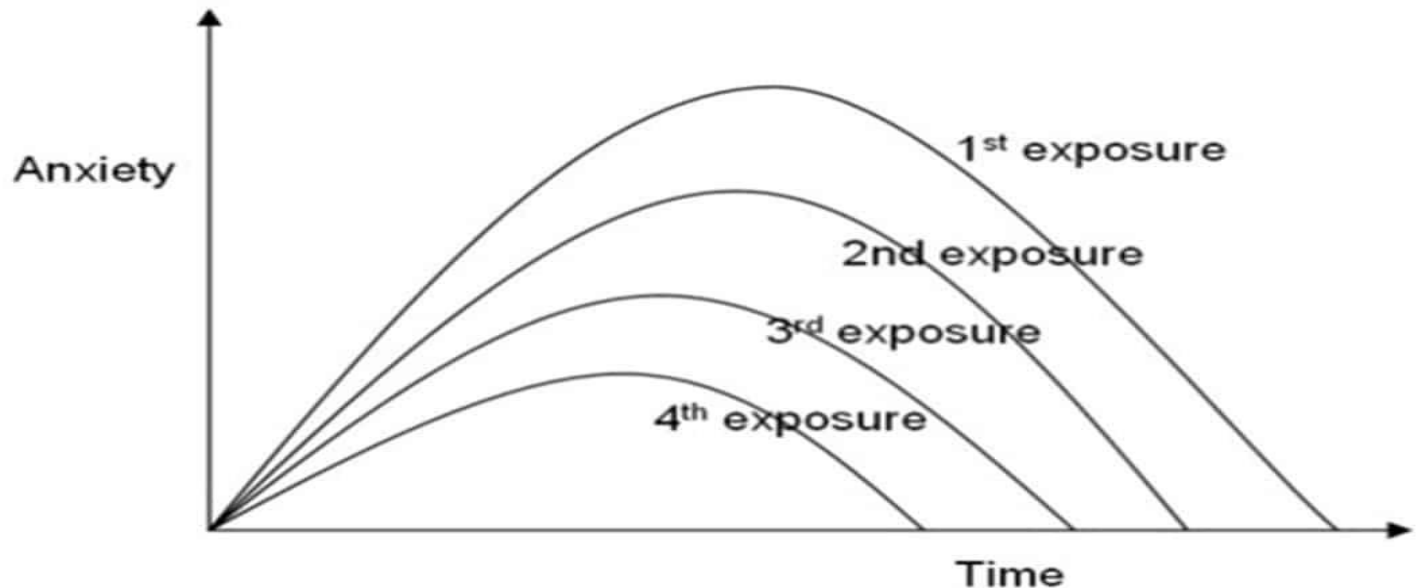
After the initial 24 hours following a concussion, the individual should MAINTAIN A REGULATED SCHEDULE.

TREATMENT OPTIONS



Avoidance and rumination strategies may reduce anxiety temporarily but maintain it over time. Encourage active coping on a day-to-day basis.

- Exposure to fear-eliciting stimuli or situations
- Prevention of avoidant behaviors
- Foster adaptive coping and processing of new learning/corrective information
- Gradual habituation to symptoms over time, repeated trials



RETURN TO LEARN

Attendance Restrictions	Full Days Modified Days No School
Testing	Extra time, testing in a quiet environment, testing across multiple sessions, reduced length for examinations, enlarged font/reduced items on a page, no tests or quizzes
Workload Reduction	Focus on completion of essential work only, reduce overall amount of make-up work, shorten tests/projects, limit computer work
Note Taking	Providing notes to students
Breaks	Short breaks (5-15 minutes) every 1-2 hours as needed for symptom management or once symptoms reach a 5/10 severity level. Examples of breaks include putting their head down on the desk to rest or stepping out into the hall for several minutes rest prior to returning to class. During a break, this students should not be using a cell phone or engaging in other activities, as the most benefit will come from reduced stimuli.
Extra Time	Extra time to turn in and complete assignments
Other Accommodations	Snacks/Drinks Avoid busy environments (i.e., leave class early to avoid hallways)

RETURN TO PLAY: EXAMPLE FOR SOCCER

Stage	Activity	
Non-Contact Activity	Light Activity Objectives: Activity with limited head motion/rotation, increased heart rate above resting	Walking, stationary bike, individual/team stretching, core exercises, lunges, squats
	Moderate Activity Objectives: Elevated heart rate for a sustained length of time, increase head motion/rotation, sport specific fundamental skills	Passing (1-1, pass with jogging), shooting (dribbling to shoot), dribbling (straight line, change of direction), goalie (catching drills, punting/goal kick drills)
	Maximal Activity Objectives: Maximum heart rate, full range of motion for head/body	Offense against air, clearing drills, group passing/control drills, goalie (1-1 shooting, 1-1 crease work)
Contact Activity	Light/Incidental Contact	Incidental contact scrimmage (1/2 field progressing to full), controlled ball toss header drills, goalie (multiple players on field dives)
	Full Contact	Set piece practices, full participation scrimmages
	Game Play	Game play



QUESTIONS?

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