

Return to Play: Post-Concussion and DDX

R. Robert Franks, D.O., FAOASM

Director Sports Concussion Institute

Rothman Institute

Associate Professor Family Medicine, Thomas Jefferson
University

Clinical Associate Professor Family Medicine, RowanSOM

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Disclosures

- I have no disclosures to make concerning the following lecture.

Objectives

Upon completion of this lecture, the participant will be able to:

- * Formulate an appropriate assessment and plan in the care and treatment of the concussed athlete.
- * Understand how to use the members of the concussion care team to assist in the care and treatment of the concussed athletes.

Objectives

- If you take home one point from this lecture, this is it
- **REST IS NO LONGER BEST, the new mantra is EXPOSE AND RECOVER**



Objectives

- Per Berlin 2016, multiple studies support gradually increasing sub threshold symptomological activity before full contact risk
- Expose and recover
 - Cannot manage a concussion with a protocol
 - Identification of symptom categories should guide treatment
 - Cannot use a consensus statement or protocol alone

Structural Changes from Berlin 2016

- Paper divided into the 11 Rs for organization of differences between past four conferences.
- Renumbering of Adult and Pediatric SCAT from 3 to 5 to coincide with the number of the meeting of the Concussion in Sport Group.

11 Rs of Sport Related Concussion (SRC)

1. Recognize
2. Remove
3. Re-evaluate
4. Rest
5. Rehabilitation
6. Refer
7. Recover
8. Return to Sport
9. Reconsider
10. Residual Effects and Sequelae
11. Risk Reduction

Key Historical Points

- Berlin 2016
 - SRC – Sport Related Concussion is new terminology
 - Concussion symptoms may be immediate or evolve over time
 - Extended concussion symptoms must not be explained by drug, alcohol, medication use, other injuries or other co-morbidities such as psychological conditions or coexisting medical conditions

Recognize/Remove

- SCAT5 and Child SCAT5
 - Child is ages 5 to 12 and adolescent 13 to 18
 - Per Berlin 2016, best instrument for sideline assessment
 - Utility decreases in 3 to 5 days
 - Baseline can be done and post tests should mimic baseline conditions
 - Helmet technology at present is not appropriate to assess concussion
 - Sideline review shows promise in assistance with diagnosis of concussion

Key Historical Points

- According to Berlin 2016, condition of patient over first 24 to 48 hours dictates level of difficulty of patient recovery
- Patients with history of migraines or mental health issues are more likely to have symptoms greater for one month

Key Historical Points

- Concussion is underreported and often unrecognized
- Do not have to involve loss of consciousness
- Headache is most often reported symptom
- The adolescent brain recovers slower than the adult brain
- Emerging female predominance

Key Historical Points

- If an athlete has had a concussion, they are 4-6 times more likely to have a second
- Subsequent hits, although lesser in nature, may produce worse symptoms
- Thus, a complete history of past concussions, with emphasis on LOC and type of amnesia is critical
- Athletes with co-morbid headache history or associated mental health issues may need special consideration

Key Historical Questions

- Does the athlete have pre-existing motion sickness
- How many head injuries has the patient had in the past?
- How did they occur?
- What type of symptoms did they have?
- How long did the symptoms last?
- Were they associated with LOC or amnesia, and what type?

Key Historical Questions

- Do they have a pressure headache and does it get worse with school or exertion?
- Do they get dizzy with movement?
- Do they get fatigued at a certain point in the day?
- Are they more sensitive to light/noise?
- Are they more distracted?
- Are they have trouble falling/staying asleep?
- Are they more moody/irritable?

Key Historical Questions

- Do they feel “foggy”?
- How many practices/competitions did they miss?
- Did the symptoms affect classes and their grades?
- How long did it take them to “feel themselves”?
- Did they have any “dings” or hits to chest, neck, or face that radiated to head that were unreported as concussion?
- Does the patient wear glasses or contact lenses and what type

Symptom Categorization

- Rothman Concussion Program as printed in OFP looks at categorization as modified from UPMC.
- UPMC
 - Vestibular
 - Ocular
 - Cervicogenic
 - Anxiety/Mood
 - Cognitive/Fatigue
 - PTM (Post Traumatic Migraine)

Modified UPMC Symptom Categorization

- Cervicogenic
 - Dysfunction to the cervical spine

Modified UPMC Symptom Categorization

- Cognitive Symptoms
 - Attention Problems
 - Dysfunction
 - Fogginess
 - Fatigue
 - Cognitive Slowing

Modified UPMC Symptom Categorization

- Emotionality
 - More emotional
 - Sadness
 - Nervousness
 - Irritability

Modified UPMC Symptom Categorization

- Sleep Disturbance
 - Difficulty falling asleep
 - Sleeping less than usual

Modified UPMC Symptom Categorization

- Vestibular
 - Ability of ophthalmologic and neurological systems and body (eyes, brain, and body) to work together

Modified UPMC Symptom Categorization

- Ocular
 - Ability of ophthalmologic system to work appropriately
 - Are vergence and divergence, smooth pursuits, saccades, accommodation, convergence, VOR and VOR cancellation appropriate,

Optometric Conditions

- Optometric Issues
 - Convergence Insufficiency
 - Important for reading
 - Inability to use two eyes together as a team
 - Oculomotor Dysfunction
 - Permits accurate visual scanning and exploration
 - Important for reading and copying from board
 - Inability for eyes to together track a moving target and switch fixation from one target to another

Optometric Conditions

- Optometric Issues
 - Accommodative Infacility
 - Important for academic efficiency and comfort to focus on an object – i.e. copy from blackboard
 - Inability to allow rapid and accurate shifts of attention from one distance to another with instantaneous clarity
 - Inability to allow student to maintain focus at reading distance

Optometric Conditions

- Optometric Issues
 - Visual Intake-Visual Memory
 - Allows for optimal academic and athletic performance as affects proficiency in reading comprehension and spelling
 - Inability to obtain maximum visual information in the shortest possible time
 - Inability to retain this information over an adequate period of time

Optometric Conditions

- Optometric Issues
 - Visual Motor Integration Deficit
 - Inability to analyze a visual stimulus, integrate that information with other systems, and produce a motor response (inappropriate eye-hand coordination)
 - Needed to produce written language
 - Fusional Instability
 - Inappropriate binocular function
 - Needed for near and distant visual tasks
 - Cause of blur or double vision

UPMC Symptom Categorization

- Post-Traumatic Migraine
 - Headache with nausea and photo or phono phobia
 - Adolescence has risk for new onset migraine
 - Familial migraine history can be trigger for PTM in concussion patients

Physical Examination

Vitals

Speech

Gait analysis

DTRs

MS UE and LE b/l

Sensation UE and LE b/l

Cranial Nerve Examination

Physical Examination

Romberg Test (Balance and Motor
Coordination)

Pronator Drift Test (Upper Motor Neuron
Testing)

Tandem Walk (Coordination)

Heel to Shin (Balance and Coordination)

Finger to Nose (Point to Point Coordination)

VOMS – Vestibular-Ocular Motor Screen

VOMS Physician Examination

1. Smooth Pursuit – Extra-ocular Muscle Testing

VOMS Physician Examination

2. Saccades Testing

- Point to Point Discrimination in horizontal and vertical planes (Fingers 12 inches apart and patient looks between them for 15 seconds.)
- Look for latency of onset, speed, accuracy and conjugate movement. Test failure is delayed, inaccurate saccades or disconjugate eye movement.

VOMS Physician Examination

3. Vestibulo-Ocular Reflex (VOR) – Gaze Stability

- Ability to focus on stationary object while moving head without blurriness or dizziness
- Do with examiner finger stationary and patient moving head side to side while fixating on stationary finger
- Test in horizontal and vertical plane for 15 seconds
- Look for inability to hold focus
- With provocation, see decline in visual motor speed and reaction time

VOMS Physician Examination

4. Visual Motion Sensitivity (VOR Cancelation)

- Response to optokinetic stimulation
- Patient focus on thumb as moves side to side following own thumb
- Look for inability to follow fixated object
- With provocation, see decline in visual motor speed and reaction time

VOMS Physician Examination

5. Near Point Convergence Dysfunction Test

- Focus on writing on pen 6 cm from nose bridge
- Look for diplopia at greater than 6 cm

VOMS Physician Examination

6. Test of Near Point Accommodation

- Cover one eye
- Bring object to face
- Should accommodate – see clear at 15 cm
- Can fatigue system by bringing closer

Vestibular Examination

- BESS (Balance Error Scoring System)
 - 3 Tests 6 different balance conditions lasting 20 seconds
 - Stance settings – double leg, single leg, and tandem done on three surfaces – stable/firm and unstable/foam.
 - Score determined by amount of errors recorded during different balance conditions – one point for each error
 - Increased error reflect increased problems with balance and coordination post concussion

Vestibular Examination

- Balance Testing
 - Patient self report (Activity Specific Confidence Scale or Falls Efficacy Scale)
 - BPPV Testing
 - **Sway Balance**
 - Testing Platform (i.e. Biosway)
 - Computerized Dynamic Posturography

Classification

- Panel adopted that 80-90% of all concussions resolve in short 7-10 day period
- Persistent symptoms or PCS symptoms now defined as symptoms greater than the following:
 - Adults 14 days
 - Children 4 weeks

Imaging

- Vienna conference recognized that conventional neuroimaging is usually normal.
- Use in cases where there is suspicion of cerebral bleed, prolonged disturbance of conscious state, focal neurological deficit, seizure activity or persistent clinical or cognitive symptoms.

Imaging

- Additional Neuroimaging Considerations
 - MRI (with DTI)
 - Use of gradient echo, perfusion and diffusion weighted images better choice to distinguish structural brain abnormalities
 - High definition fiber tracking next stage of DTI – fails with crossing axons
 - PET Scan
 - Used often in concussion research but not yet standard of care
 - Magnetic resonance spectroscopy
 - Functional connectivity

Imaging

- fMRI
 - Administration of MRI while patient undergoes cognitive challenge
 - See signaling in dorsolateral pre-frontal cortex corresponding to memory centers of brain
 - These areas often correspond with areas with altered brain metabolism seen with concussion research studies

Neuropsychological Assessment

- Most often done in asymptomatic athletes to aid in return to return to play decisions.
- Acceptable to do in symptomatic child and adolescent athletes to determine management.
- Should not be sole basis for management or return to play decisions but aid in clinical decision making.

Neuropsychological Assessment

- Should test cognitive domains of information processing, planning, memory, and switching mental set.
- Examples of tests include pen and paper tests, comprehensive protocols administered by neuropsychologists, and computerized test platforms.
- Ideally, there should be baseline pre-season testing followed by post-injury serial follow-up, especially true of elite athletes.

Neuropsychological Assessment

- Gold standard remains formal neuropsychological examination by a trained neuropsychologist ideally trained in Sports Medicine
- Today, most often, computer neuropsychological testing is performed on athletes for rapid screen and to assess recovery.
- These tests include ImPACT, CogSports, Head Minders, and CNS Vital Signs to name a few

Neuropsychological Assessment

- Computer neuropsychological testing looks at the following domains:
 - Verbal memory
 - Visual memory
 - Visual motor speed component
 - Reaction time

Only 55% of ATCs look at baseline testing

Baseline testing is often unavailable at time of patient visit

ImPACT Critical Numbers

- Verbal memory – 90
- Visual memory – 80
- Visual Motor Speed Composite – 40
- Reaction Time – less than 0.55
- Symptom Score – 9

ImPACT RCI Scores

- Verbal memory – greater than 8.75
- Visual memory – greater than 13.5
- Visual Motor Speed Composite – greater than 4.98
- Reaction Time – greater than 0.06
- Symptom Score – greater than 9.6

Treatment Goals

- Keys are to do the following:
 - Recognize, Remove, Re-evaluate, Rest, Rehabilitation, Refer, Recover, Return to Sport, Reconsider, Residual Effects, and Risk Reduction
- Prevent Second Impact Syndrome
- Prevent cumulative effects of concussion
- Prevent Post Concussion Syndrome
- Alleviate symptoms

Treatment Goals

- Per Berlin, clinicians must determine whether extended recovery in some patients is due to premorbid maladies, downstream effects of SRC, or unrelated challenges while being mindful of the potential for repeat injuries when returning patients to sports too early
- These conditions include **chronic migraine, anxiety, post traumatic stress disorder, attention problems, and sleep dysfunction**

Treatment

- Per Berlin, the physiological time of recovery may outlast the time for clinical recovery

Rest

- 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 (ie, 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.

Rehabilitation

- SRCs can result in diverse symptoms and problems, and can be associated with concurrent injury to the cervical spine and peripheral vestibular system. **The literature has not evaluated early interventions, as most individuals recover in 10–14 days.** A variety of treatments may be required for ongoing or persistent symptoms and impairments following injury. The data support interventions including psychological, cervical and vestibular rehabilitation.
- In addition, **closely monitored active rehabilitation programs involving controlled sub-symptom-threshold, submaximal exercise have been shown to be safe and may be of benefit in facilitating recovery.** A collaborative approach to treatment, including controlled cognitive stress, pharmacological treatment, and school accommodations, may be beneficial.
- Further research evaluating rest and active treatments should be performed using high-quality designs that account for potential confounding factors, and have matched controls and effect modifiers to best inform clinical practice and facilitate recovery after SRC.

Refer - Persistent Symptoms

- A standard definition for persistent post-concussive symptoms is needed to ensure consistency in clinical management and research outcomes. The Berlin expert consensus is that use of the term ‘persistent symptoms’ following SRC should reflect failure of normal clinical recovery—that is, symptoms that persist beyond expected time frames
- These time frames are >10–14 days in adults and >4 weeks in children.

Refer - Persistent Symptoms

- Persistent symptoms do not reflect a single pathophysiological entity, but describes a constellation of non-specific post-traumatic symptoms that may be linked to coexisting and/or confounding factors, which do not necessarily reflect ongoing physiological injury to the brain.
- A detailed multimodal clinical assessment is required to identify specific primary and secondary pathologies that may be contributing to persisting post-traumatic symptoms.
- At a minimum, the assessment should include a comprehensive history, focused physical examination, and special tests where indicated (eg, graded aerobic exercise test).
- Currently, while there is insufficient evidence for investigations, such as EEG, advanced neuroimaging techniques, genetic testing and biomarkers, to recommend a role in the clinical setting, their use in the research setting is encouraged.

Recovery

- The strongest and most consistent predictor of slower recovery from SRC is the severity of a person's initial symptoms in the first day, or initial few days, after injury.
- Conversely, and importantly, having a low level of symptoms in the first day after injury is a favorable prognostic indicator.

Recovery

- The development of subacute problems with migraine headaches or depression are likely risk factors for persistent symptoms lasting more than a month.
- Children, adolescents and young adults with a pre-injury history of mental health problems or migraine headaches appear to be at somewhat greater risk of having symptoms for more than 1 month.
- Those with attention deficit hyperactivity disorder or learning disabilities might require more careful planning and intervention regarding returning to school, but they do not appear to be at substantially greater risk of persistent symptoms beyond a month.

Recovery

- Very little research to date has been carried out on children under the age of 13.
- There is some evidence that the teenage years, particularly the high-school years, might be the most vulnerable time period for having persistent symptoms—with greater risk for girls than boys.

Recovery - Establishing Time of Recovery for SRC

- Establishing the time of recovery after an SRC is a difficult task for healthcare providers.
- These determinations have been limited by lack of a gold standard as well as subjective symptom scores and imperfect clinical and NP testing.
- In addition, patients frequently experience more persistent symptoms, including, but not limited to, chronic migraines, anxiety, post-traumatic stress disorder (PTSD), attention problems and sleep dysfunction.

Recovery - Establishing Time of Recovery for SRC

- Clinicians must determine whether these are premorbid maladies, downstream effects of SRC, or unrelated challenges while being mindful of the potential for repeat injuries when returning patients to sport too early. Providers are often left in a quandary with limited data to make decisions.
- Moreover, recent literature suggests that the physiological time of recovery may outlast the time for clinical recovery. The consequence of this is as yet unknown, but one possibility is that athletes may be exposed to additional risk by returning to play while there is ongoing brain dysfunction.

Recovery - Establishing Time of Recovery for SRC

In a research context, modalities that measure physiological change after SRC can be categorised into the following:

- functional MRI (fMRI)
- diffusion tensor imaging (DTI)
- magnetic resonance spectroscopy (MRS)
- cerebral blood flow (CBF)
- electrophysiology
- heart rate
- measure of exercise performance
- fluid biomarkers
- trans-cranial magnetic stimulation (TMS).

Recovery - Establishing Time of Recovery for SRC

- Owing to differences in modalities, time course, study design and outcomes, it is not possible to define a single ‘physiological time window’ for SRC recovery.
- Multiple studies suggest that physiological dysfunction may outlast current clinical measures of recovery, supporting a ‘buffer zone’ of gradually increasing activity before full contact risk.
 - Thus, submaximal threshold rehabilitation is different than return to play.
- Future studies need to use generalizable populations, longitudinal designs following to physiological and clinical recovery, and careful correlation of neurobiological modalities with clinical measures.
- At this stage, these modalities, while useful as research tools, are not ready for clinical management.

First Line Overall Treatment

- 3 meals a day with heavy emphasis on protein ingestion
- Increased hydration – 80 oz per day
- Sleep 7 to 9 hours per night – no naps, electronics in bedroom
- Exercise – start with walking

UPMC Modified Symptom Categorization Treatment

- Vestibular
 - 60 % of cases
 - VOR and VMS are provocative showing decline in visual motor speed and possibly reaction time on ImPACT
 - Propensity to become anxious
 - See more dynamic vestibular symptoms than static

UPMC Modified Symptom Categorization Treatment

- Vestibular
 - Treatment
 - Vestibular Therapy
 - Exposure/Recovery
 - Behavioral Management
 - Exertion
 - Medications
 - Klonopin, SSRIs, Tricyclics, Sleep Meds

UPMC Modified Symptom Categorization Treatment

- Anxiety/Mood
- Stress – see onset as quickly as 2 weeks and worsens with rest – highly underreported
 - immediate consideration of referral
 - Continued symptom inventory
 - Cannot turn off thoughts
 - Increased symptoms if think of symptoms
 - Refusal to attend social activities
 - Continued parental questioning of symptoms
 - Sleep problems are often co-morbid

UPMC Modified Symptom Categorization Treatment

- Anxiety/Mood
- VOMS nil or mildly provocative – if vestibular overlay treat vestibular signs first
- Often see in presence of great ImPACT scores but high symptom complaints

UPMC Modified Symptom Categorization Treatment

- Anxiety/Mood
- Treatment
 - Therapy (Cognitive Behavioral Therapy)
 - Exposure
 - Exertion
 - Behavior Regulation – diet, exercise, hydration, stress
 - Medications
 - SSRIs
 - Benzos

UPMC Modified Symptom Categorization Treatment

- Ocular
 - 42 to 69 % of patients report this
 - Frontal headache, tired behind eyes
 - Problems in math and science
 - End of day fatigue
 - See issues with near point convergence, accommodation, pursuits, saccades on VOMS
 - See decrease in verbal memory, visual motor speed composite and reaction time
 - Problem is in encoding not retrieval

UPMC Modified Symptom Categorization Treatment

- Ocular
 - Treatment
 - Vestibular Therapy
 - Vision Therapy – may have to do visual therapy before vestibular if extremely symptomatic
 - Exertion Therapy
 - ? Treatment for stress/anxiety

UPMC Modified Symptom Categorization Treatment

- Cognitive/Fatigue
 - 52% of patients report
 - Worsened with learning disability/ AD/HD co-morbidity
 - Headache increases as day evolves
 - More fatigued at end of the day
 - VOMS grossly normal
 - Global decrease in ImPACT and worsens as test continues
 - Deficits with retrieval as opposed to encoding

UPMC Modified Symptom Categorization Treatment

- Cognitive/Fatigue
 - Treatment
 - Educational accommodations (Breaks, etc.)
 - Cognitive Rehabilitation
 - Medications
 - Amantidine
 - Stimulants
 - Sleep Aids

UPMC Modified Symptom Categorization Treatment

- Cervicogenic
 - Caused by axial load and
 - Upper cervical – aa, oa – rotatory forces
 - Lower cervical – rotational and side bending forces
 - Look at flexion, extension, right and left rotation, right and left side bending
 - Look at neck strength

UPMC Modified Symptom Categorization Treatment

- Cervicogenic
 - Treatment
 - OMM
 - PT
 - TENS
 - Muscle Relaxers
 - Thoracolumbar support bracing
 - Trigger point injections
 - Facet injections
 - Epidurals/Nerve Blocks

UPMC Modified Symptom Categorization Treatment

- Post Traumatic Migraine
 - Headache with nausea and photo/phono phobia
 - Often associated with stress
 - VOMS normal
 - Verbal and visual memory deficits, if vestibular involved as well, see deficiencies in visual motor speed as well

UPMC Modified Symptom Categorization Treatment

- Post Traumatic Migraine
 - Treatment
 - Diet, Hydration, Stress, Exercise regulation
 - Tricyclics, Propranolol

Return to School/Sport

- RTS/RTS after SRC should continue to be step-wise
 - Initial rest (24-48 hrs)

Consensus statement

Table 2 Graduated return-to-school strategy

Stage	Aim	Activity	Goal of each step
1	Daily activities at home that do not give the child symptoms	Typical activities of the child during the day as long as they do not increase symptoms (eg. reading, texting, screen time). Start with 5–15 min at a time and gradually build up	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 increased breaks during the day	Increase academic activities
4	Return to school full time	Gradually progress school activities until a full day can be tolerated	Return to full academic activities and catch up on missed work

When a concussion is suspected, the athlete should be removed from the sporting environment and a multimodal assessment should be conducted in a standardised fashion (eg, the SCAT5). Sporting bodies should allow adequate time to conduct this evaluation. For example, completing the SCAT alone typically takes 10 min. Adequate facilities should be provided for the appropriate medical assessment both on and off the field for all injured athletes. In some sports, this may require rule changes to allow an appropriate off-field medical assessment to occur without affecting the flow of the game or unduly penalising the injured player's team. The final determination regarding SRC diagnosis and/or fitness to play is a medical decision based on clinical judgement.

Re-evaluate

An athlete with SRC may be evaluated in the emergency room

and, in particular, any return-to-play protocol.^{18 19} It must be emphasised, however, that NP assessment should not be the sole basis of management decisions. Rather, it provides an aid to the clinical decision-making process in conjunction with a range of assessments of different clinical domains and investigational results.

It is recommended that all athletes should have a clinical neurological assessment (including evaluation of mental status/cognition, oculomotor function, gross sensorimotor, coordination, gait, vestibular function and balance) as part of their overall management. This will normally be performed by the treating physician, often in conjunction with computerised NP screening tools.

Brief computerised cognitive evaluation tools are a common utilised component of these assessments worldwide given the logistical limitation in accessing trained neuropsychologist

Return to School

- Step One
 - Daily activities at home that do not give symptoms such as texting, reading, etc. Goal is gradual return to typical activities
- Step Two
 - School activities such as homework or reading. Goal is increase tolerance to cognitive work

Return to School

- Step Three
 - Return to school part time with gradual introduction of schoolwork. Goal is to increase academic activities
- Step Four
 - Return to school full time with gradual progression to full day of work. Goal is return to full activities and make up missed work

Table 1 Graduated return-to-sport (RTS) strategy

Stage	Aim	Activity	Goal of each step
1	Symptom-limited activity	Daily activities that do not provoke symptoms	Gradual reintroduction of work/school activities
2	Light aerobic exercise	Walking or stationary cycling at slow to medium pace. No resistance training	Increase heart rate
3	Sport-specific exercise	Running or skating drills. No head impact activities	Add movement
4	Non-contact training drills	Harder training drills, eg, passing drills. May start progressive resistance training	Exercise, coordination and increased thinking
5	Full contact practice	Following medical clearance, participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6	Return to sport	Normal game play	

NOTE: An initial period of 24–48 hours of both relative physical rest and cognitive rest is recommended before beginning the RTS progression. There should be at least 24 hours (or longer) for each step of the progression. If any symptoms worsen during exercise, the athlete should go back to the previous step. Resistance training should be added only in the later stages (stage 3 or 4 at the earliest). If symptoms are persistent (eg, more than 10–14 days in adults or more than 1 month in children), the athlete should be referred to a healthcare professional who is an expert in the management of concussion.

determine the disposition and timing of return to play for that athlete.

We acknowledge that many contact sports are played at a fast pace in a disorganised environment, where the view of on-field incidents is often obscured and the symptoms of SRC are diverse, some of which adds to the challenge of the medical assessment of suspected SRC. Furthermore, evolving and delayed-onset symptoms of SRC are well documented and highlight the need to consider follow-up serial evaluation after a suspected SRC regardless of a negative sideline screening test or normal early evaluation.

The recognition of suspected SRC is therefore best approached using multidimensional testing guided via expert consensus. The following represents the most well-established and rigor-

ously validated testing procedures. Testing should be performed, and symptoms may be delayed, erring on the side of caution (ie, keeping an athlete out of participation when there is any suspicion of injury) is important.

The diagnosis of acute SRC involves the assessment of a range of domains including clinical symptoms, physical signs, cognitive impairment, neurobehavioral features and sleep/wake disturbance. Furthermore, a detailed concussion history is an important part of the evaluation both in the injured athlete and when conducting a pre-participation examination.

The suspected diagnosis of SRC can include one or more of the following clinical domains:

- a. Symptoms: somatic (eg, headache), cognitive (eg, feeling like in a fog) and/or emotional symptoms (eg, lability)

Return to Sport

- Never return player who still has concussive symptoms.
- Patient requires physical and cognitive rest
- This includes activities that require concentration and attention
 - School Work
 - Video Games
 - Text Messaging
- If symptoms have resolved with rest, test patient with exertion.

Return to Sport

- Player should proceed stepwise.
- If post-concussive symptoms recur, the athlete should drop back to previous asymptomatic level and attempt progression again in 24 hours.
- Should not be taking any pharmacological agents that may effect or change symptoms of concussion.
- Should have neuropsychological testing return to baseline

Return to Sport

- No activity
 - Complete rest
 - Recovery Phase
- Once asymptomatic for 24 hours, proceed to step 2

Return to Sport

- Light aerobic exercise
 - Walking
 - Swimming
 - Stationary Cycling
 - All Less Than 70 % MPHR
 - No Resistance Training
- – Increase HR

Return to Sport

- Sport-specific training
 - Skating drills in ice hockey
 - Running in soccer
 - No head impact activities
 - Add movement

Return to Sport

- Noncontact training drills
 - Progression to more complex training drills
 - Passing drills in football
 - Passing drills in hockey
 - May begin progressive resistance training
 - Exercise, coordination, and cognitive load

Return to Sport

- Full-contact training after medical clearance
 - Restore confidence and assess functional skills by coaching staff
- Return to game play

Return to Sport

- No child or adolescent athlete, including the collegiate athlete, no matter the skill level, should return to play on the same day.
- Some NFL studies have shown no risk of recurrence or sequela with same day RTP in presence of physicians with experience and rapid neurocognitive assessment.
 - However, full clinical and cognitive recovery must occur before consideration of RTP

Reconsider (Special Populations) - Elite and Non-Elite Athletes

All athletes, regardless of level of participation,
should be managed using the same
management principles.

Reconsider (Special Populations) - The Child Athlete -

- The management of SRC in children requires special paradigms suitable for the developing child.
- The paucity of studies that are specific to children, especially younger children, needs to be addressed as a priority, with the expectation that future CISG consensus meetings will have sufficient studies to review that are age-specific, of high quality, and with a low risk of bias.

Reconsider (Special Populations) - The Child and Adolescent Athlete

- Child and adolescent guidelines refer to individuals 18 years or less.
- Child-specific paradigms for SRC should apply to children aged 5–12 years
- adolescent-specific paradigms should apply to those aged 13–18 years.
- The literature does not adequately address the question of age groups in which children with SRC should be managed differently from adults. No studies have addressed whether SRC signs and symptoms differ from adults.
- The expected duration of symptoms in children with SRC is up to 4 weeks, and further research is required to identify predictors of prolonged recovery.
- It is recommended that age-specific validated symptom-rating scales be used in SRC assessment, and further research is required to establish the role and utility of computerized NP testing in this age group.
- Similar to adults, a brief period of physical and cognitive rest is advised after SRC followed by symptom-limited resumption of activity.

Reconsider (Special Populations) - The Child and Adolescent Athlete

- Schools are encouraged to have an SRC policy that includes education on SRC prevention and management for teachers, staff, students and parents, and should offer appropriate academic accommodation and support to students recovering from SRC.
- Students should have regular medical follow-up after an SRC to monitor recovery and help with return to school, and students may require temporary absence from school after injury.
- Children and adolescents should not return to sport until they have successfully returned to school. However, early introduction of symptom-limited physical activity is appropriate.

Residual Effects and Sequelae

- The literature on neurobehavioral sequelae and long-term consequences of exposure to recurrent head trauma is inconsistent.
- Clinicians need to be mindful of the potential for long-term problems such as cognitive impairment, depression, etc in the management of all athletes.
- There is much more to learn about the potential cause-and-effect relationships of repetitive head-impact exposure and concussions.
- The potential for developing chronic traumatic encephalopathy (CTE) must be a consideration, as this condition appears to represent a distinct tauopathy with an unknown incidence in athletic populations.
- A cause-and-effect relationship has not yet been demonstrated between CTE and SRCs or exposure to contact sports. As such, the notion that repeated concussion or subconcussive impacts cause CTE remains unknown.

Risk Reduction

- Mandate helmet use in skiing and snowboarding
- Questionable effect of mouthguards
- Decrease body checking in youth hockey
- Injury Preventive Strategies
 - Vision training in NCAA football
- Knowledge translation (KT) is critical

Risk Reduction – Knowledge Translation

- Knowledge Translation (KT) is an important part of SRC education.
- KT should assess knowledge gaps, identify, develop and evaluate education strategies, and use the outcomes to facilitate decision-making.
- KT must keep pace with evolving knowledge of SRC.

Medicolegal Aspects of Concussion

- Currently all 50 states have some kind of concussion legislation
- It is imperative that you know the specifics concerning the laws of the state(s) in which you practice.
- Washington state was first state with an official concussion law – The Lystedt Law

Medicolegal Aspects of Concussion

- Schools are encouraged to have SRC Policy that includes the following:
 - Education on SRC prevention and management for teachers, staff, students, and parents
 - Should offer academic accommodation and support to athletes with SRC
 - Encourage regular medical follow up to monitor recovery and return to school
 - Provide for temporary absence from school after SRC

CONC	6	Athletes suspected of a concussion are not permitted to return to participation until written release from a qualified licensed healthcare professional (i.e. physician, athletic trainer, APRN, PA, etc.)	Both
	7	No child/adolescent should return to sport/activity unless he/she has managed to return to school	N
	8	Implementation of a graduated return to participation protocol following the Zurich guidelines with at least 5 steps	N
	9	Comprehensive medical-management plan for acute care of a potential head or cervical spine injury	Legislation
Legislation			2 22.22
SHSAA			2 22.22
Legislation & SHSAA			3 33.33
# / % of Policies Met			7 77.78
EAP	1	Every school or organization that sponsors athletics should develop an EAP specifically for managing serious and/or potentially life-threatening sport-related injuries (athletics emergency action plan AEAP)	SHSAA
	2	The AEAP should be developed and coordinated with local EMS, school public safety officials, on site medical personnel or school medical staff, and school administrators	SHSAA
	3	Every school should distribute the AEAP to all athletics staff members	SHSAA
	4	The AEAP should be specific to each venue (including maps, directions, etc.)	SHSAA
	5	On-site emergency equipment that may be needed in an emergency situation should be listed	SHSAA
	6	The AEAP should identify personnel and their responsibilities to carry out the plan of action with a designated chain of command	SHSAA
	7	Appropriate contact information for EMS	N
	8	Plan should specify documentation actions that need to be taken post emergency	N
	9	AEAP should be reviewed and rehearsed annually by all parties involved	SHSAA

		New Jersey	
AED	1	AEDs are to be used under the advice and consent of a physician by individuals with proper training and certification	Legislation
	2	AED should be stored in a safe place	Both
	3	All athletic trainers, coaches, administrators, school nurses, and physical education teachers should have access to an AED on school property	Both
	4	Institutions sponsoring athletic events/activities should have a AED on site or access to one at each athletic venue for practices, games, or other athletic events	Both
	5	Individuals [all personnel involved with sponsored athletic events/activities] should be provided annual training and certification in cardiopulmonary resuscitation (CPR) and AED use	Both
	6	Location of AED should be well marked, publicized, accessible and known among trained staff	Both
	7	The AED should be used only after enacting the EMS system.	Legislation
	8	AEDs should be inspected frequently to ensure proper working order. This includes making sure the batteries are charged, and wires and electrodes are in good condition	Both
Legislation		2 25.00	
SHSAA		0 0.00	
Legislation & SHSAA (Both)		6 75.00	
# /% of Policies Met		8 100.00	
CONCUSSION	1	Schools should develop a referral plan for concussions	Both
	2	Use certified helmets/equipment	SHSAA
	3	The PPE (preparticipation exam) should include concussion specific questions	SHSAA
	4	Preseason education for personnel, coaches, athletes and parents (should be tailored to the group being taught) on basics of concussion (i.e. that helmets do not prevent cerebral concussions, signs/symptoms, treatment, testing options, RTP)	Legislation
	5	High school athletes suspected of sustaining a concussion are not permitted to return to a practice, game, or activity involving exertional activity on the same day.	Both

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Thank You



The Underdog