2019 Concussion Update

R. Robert Franks, DO FAOASM
Director, Rothman Concussion Institute
Rothman Institute
Associate Professor Family Medicine, Thomas Jefferson University
Clinical Associate Professor Family Medicine, RowanSOM
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ROTHMAN ORTHOPAEDICS

Introduction

- Sports related concussion (SRC) continue to be a cause of concern for physicians based upon media coverage and continued legislation.
- The lack of definitive outcomes-based data continues to rely on the best available evidence and consensus integrated with clinical experience and patient value and outcomes.

Papers Reviewed

- Harmon KG, et al. American Medical Society for Sports Medicine Position Statement: Concussion in Sport. Br J Sports Med. 2019 Feb; 53(4): 213-225.
- Franks RR, et al. Current Concepts in the Office Based Treatment of the Concussed Athlete. OFP. 2018 Sept/Oct; 10(5): 32-43.
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Who Should Evaluate and Manage SRC?

- Healthcare professionals with appropriate training and experience; however, official educational requirements locally or nationally have not been established.
- While the majority of SRC's resolve within 7 days to 4 weeks, those with a complicated course or prolonged recovery may require a multidisciplinary healthcare team with expertise in concussion management.

Definition of Sports Related Concussion

- The Concussion in Sport Group (CISG) definition of concussion has not changed.
- The clinical signs and symptoms of concussion cannot be otherwise explained by drug, alcohol, medication use, or other injuries (such as cervical injuries or peripheral vestibular dysfunction) or other co-morbidities (psychological or medical conditions).
- These are often confused for concussion by practitioners and must be reported to patients and their families.

Epidemiology

- There are 1.0-1.8 million SRCs per year in the 0-18 years age group with a subset of about 400 000 SRCs occurring in high school sports.
- Concussion rates in the USA are estimated and primarily reported by surveillance systems looking at small samples of organized college or high school sports. There is little to no data concerning organized recreational, travel, or club sports or for everyday activities such as bicycling, skiing, snowboarding, skateboarding, the fighting arts. There is little to no data for youth/early adolescent athletes in sport.
- 50 % of concussions in high school-aged adolescents are not related to organized sports and only 20% are related to organized school team sports.
- 2% and 15% of athletes engaged in organized sports will suffer a concussion during a specific season

Table 2
Seasonal risk of concussion in sports

Author	Type of athletes	Years of study	Seasons (n)	Athletes (n)	Concussed	Concussed per player/season (%)
Football						
Barr and McCrea[15]	High school and college football	1997–1999	2	1313	50	1.9
McCrea[18]	High school and college football	1998–1999	2	1325	63	2.4
McCrea *et al*[17]	High school and college football	1999–2001	3	2385	91	3.8
McCrea *et al*[19]	College football	1999–2001	2		94	3.9

Table 2
Seasonal risk of concussion in sports

Barr *et al*[16]	High school and college football	2008–2009	2	823	59	7.2
Seidman *et al*[24]	High school football	2013	1	343	9	2.6
Dompier *et al*[25]	Football	2012–2013	2	20 479	1178	5.8
	Youth football	2012–2013	2	4092	136	3.3
	High school football	2012–2013	2	11 957	767	6.4
	College football	2012–2013	2	4430	275	6.7
	College football	2011	4	9718	518	5.3

Table 2
Seasonal risk of concussion in sports

Houck *et al*[26]	College football	2006–2015	9	945*	118	12.5
Bretzin *et al*[14]	High school football	2015–2016	1	39 520	1530	3.9
Total football				**67 133**	**3192**	**4.8**
All sports						
Galetta *et al*[27]	Football, sprint football, men's and women's soccer and basketball	2010–2011	1	219	10	4.6
Marinides *et al*[20]	College athletes	2011–2012	1	217	30	13.8
Galetta *et al*[21]	Ice hockey/lacrosse youth and college		1	332	12	3.6

Table 2
Seasonal risk of concussion in sports

Leong *et al*[28]	Football, men's and women's basketball	2012–2013	1	127	11	8.7
Putukian *et al*[22]	College athletes	2011–2012	1	263	32	12.2
Chin *et al*[23]	High school and college athletes	2012–2014	3	2018	166	2.7
Kerr *et al*[12]	NCAA athletes	2011–2014	4	32 156	1410	4.4
	Men's baseball	2011–2014	4	1757	13	0.7
	Men's basketball	2011–2014	4	1889	74	3.9
	College football	2011–2014	4	9718	518	5.3

Table 2
Seasonal risk of concussion in sports

Men's ice hockey	2011–2014	4	3689	253	6.9
Men's lacrosse	2011–2014	4	1768	44	2.5
Men's soccer	2011–2014	4	1810	29	1.6
Men's wrestling	2011–2014	4	821	65	7.9
Women's basketball	2011–2014	4	1690	90	5.3
Women's ice hockey	2011–2014	4	1301	94	7.2

Table 2
Seasonal risk of concussion in sports

	Women's lacrosse	2011–2014	4	1522	49	3.2
	Women's softball	2011–2014	4	1569	38	2.4
	Women's soccer	2011–2014	4	2831	93	3.3
	Women's volleyball	2011–2014	4	1791	50	2.8
Dhawan *et al*[29]	Youth hockey		1	141	20	14.2
Tsushima *et al*[13]	Athletes grades 8–12	2013–2014	1	10 334	1250	12.1

Table 2
Seasonal risk of concussion in sports

Bretzin *et al*[14]	High school athletes in 15 sports	2015–2016	1	193 757	3352	1.7
Total				**239 564**	**6293**	**2.6**

- *Total number of athletes estimated using 105 athletes per year on football roster.
- NCAA, National Collegiate Athletic Association.

Diagnosis of Concussion

- Diagnosis is often hampered by the lack of validated, objective diagnostic tests, the reliance on athlete self-reported symptoms, and co-morbid symptoms from other associated medical conditions such as mood disorders.
- In addition, symptoms often are delayed in onset, or at first, not recognized by the athlete.

Concussion in Preseason

- Preparation should include the Pre-participation physical evaluation (PPE) and the creation and practice of an emergency action plan (EAP).
- The athlete's concussion history or that of other traumatic brain injury (TBI) including the number, recovery course and time between injuries, as well as the existence of other premorbid/comorbid conditions or modifiers of concussion should be documented.
- Learning disorder, attention deficit disorder, motion sickness or sensitivity, mood disorders or a personal or family history of migraine headaches, disorders of visual or auditory processing, and information on current medication and supplement use should be documented.

Preseason Baseline Testing

- The use of computerized neuropsychological (CNP) testing remains controversial.
- There is considerable normal variation in test performance with repeat testing in non-injured athletes; many tests are assessed a cost and continue to increase, and in younger athletes with continued neural development it is unknown when is the ideal interval to repeat baseline testing and what are the age-related differences in test performance.
- The NCAA considers “best practices” to include an initial baseline evaluation including a symptom checklist, cognitive evaluation and balance assessment. It does not require repeat annual baseline testing after an initial baseline evaluation for collegiate athletes.
- Baseline testing while useful in some cases, but is not necessary, required or an accepted standard of care for the appropriate management of SRC in all cases.

Sideline Assessment

- Reasons for immediate removal from play include loss of consciousness (LOC), impact seizure, tonic posturing, gross motor instability, confusion or amnesia, or suspicion of organic brain injury.
- Serious head injury may be suspected with prolonged LOC, severe or worsening headache, repeated vomiting, declining mental status, focal neurological deficit or suspicion of significant cervical spine injury.

Sideline Assessment

- Healthcare professional familiar with the athlete personality and co-morbidities.
- Testing should be performed in a distraction-free environment with adequate time for examination and administration of concussion tests.
- Sport-specific rules may not allow adequate time for evaluation. Consideration should be given to modifying these rules by the governing bodies of sports with inadequate evaluation times.
- Video Review is showing some utility.

Sideline Assessment

- The test-retest reliability of commonly used sideline concussion evaluation tests is below the generally accepted norms for clinical utility (0.75-0.90).
- Several concussion tests have a learning effect that must be factored into test review with repeated administration of the test.
- There is evidence that combining tests of different functions to form a multimodal assessment increases sensitivity and specificity for appropriate diagnosis of concussion.

Table 3

Psychometric properties of sideline assessment tests*

Author	Type of athletes	Athletes (n)	Concussed	Controls	Test and/or criterion	Sensitivity (%)	Specificity (%)	Test –retest reliability	AUC
Symptoms									
McCrea *et al*[19]	College football	1631	94	56		89	100		
Putukian *et al*[22]	College athletes	263	32	23	SCAT2	84	100		
Chin *et al*[23]	High school and college athletes	2018	166	164					0.88

Table 3

Psychometric properties of sideline assessment tests*

BESS									
McCrea *et al*[19]	College football	1631	94	56	Modified BESS	36	95		
Broglio *et al*[122]	Young adults	48			BESS			0.60¶	
Barr *et al*[16]	High school and college football	823	59	31	Modified BESS	31	71		
Putukian *et al*[22]	College athletes	263	32	23	Modified BESS	25	100		
Chin *et al*[23]	High school and college athletes	2018	166	164	Modified BESS			0.54†	0.56
Broglio *et al*[33]	College athletes	2894			BESS			0.41†	
Total		**4735**	**351**	**274**					

Table 3
Psychometric properties of sideline assessment tests*

Oculomotor (KD)									
Galetta *et al*[27]	Football, men's/women's basketball	219	10		Worsening of KD time	100			
Leong *et al*[123]	Boxing				Worsening of KD >5 s	100	100	0.9†	
Galetta *et al*[21]	Hockey/lacrosse youth/college	332	12	14	Worsening of KD time	75	93		0.92
Leong *et al*[28]	College football, men's/women's basketball	127	11		Worsening of KD time	89		0.95†	
King *et al*[124]	Amateur rugby					94	100	0.92†	

Table 3
Psychometric properties of sideline assessment tests*

Broglio *et al*[33]	College athletes	755						0.74†
Eddy *et al*[127]	Recreational college athletes	63						0.90†
Total		**2041**	**310**	**99**				
Clinical reaction time (dropped weighted stick)								
Eckner[128]	College football, wrestling, women's soccer	102						0.65†
Eckner *et al*[47]	High school and college athletes	28	28		90% CI	50	86	
Broglio *et al*[33]	College athletes	261						0.32†

Sideline Assessment

- While athlete symptoms are the most sensitive indicator of SRC, the reliability of athlete-reported symptoms depends on accurate reporting
- Symptom reliability may be affected by lack of recognition of the signs and symptoms of concussion or conscious false reporting to avoid loss of playing time.
- The primary role and conclusion for sideline assessment is to determine whether there is the presence of a SRC or not.

Office/Subacute Assessment

- A comprehensive history and neurological examination should be performed including details of injury mechanism, symptom trajectory, neurocognitive functioning, sleep/wake disturbance, ocular function, vestibular function, mood disorder, gait, balance and a cervical spine exam.
- The utility of sideline neurocognitive and balance assessments used to initially diagnose concussion decreases as early as 3 days after injury.
- SRC is confirmed by a clear mechanism consistent with concussion; characteristic signs, symptoms and time course of concussion; and no other co-morbidities responsible for clinical findings. It is not unusual for symptoms, signs and testing to resolve by the time of initial office visit.

Office/Subacute Assessment

- Elements of a complete examination include cervical spine evaluation, screenings for psychosocial or mental health disorders, and testing looking at the vestibular and oculomotor systems to help determine etiology of symptoms.
- Vestibular symptoms occur in 67% -77% of patients while ocular symptoms occur in approximately 45% of SRC.

Emerging Sideline Concussion Evaluation Tools

- The role of formal VOMS testing on the sideline has not yet been studied though empiric use has been promising.
- Newer technologies such as iPad balance testing do not have sufficient research to recommend their definitive use.

Helmeted and Non-Helmeted Impact Monitors

- At present, sensors may not consistently record head impacts or forces transmitted to the brain.
- At this time, impact monitors are a research tool requiring additional study and are not validated for clinical use in the diagnosis or management of SRC

Use of Biomarkers of Concussion (Imaging)

- Medical imaging is often of little utility in the diagnosis and treatment of SRC.
- MRI can be considered for atypical or prolonged recovery

Use of Biomarkers of Concussion (Fluids)

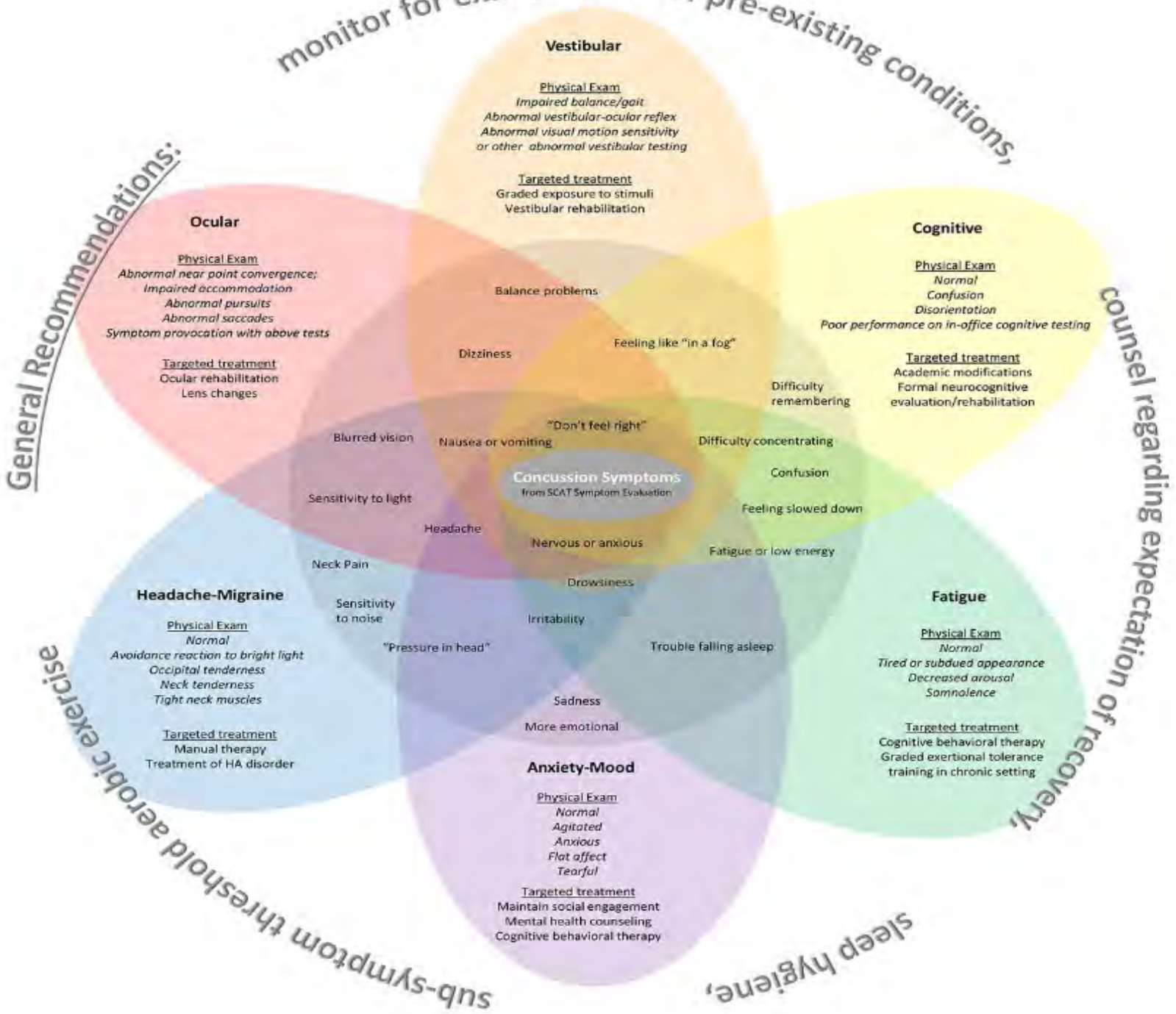
- Protein biomarkers of injury and recovery in more severe forms of civilian neurotrauma and traumatic brain injury have shown some promise; however, in recent systematic reviews, the overall level of evidence is low for using fluid biomarkers for diagnosis of SRC.
- The Federal Drug Administration (FDA) recently approved a two-protein brain trauma indicator with glial fibrillar acidic protein and ubiquitin carboxy-terminal hydrolase L1, while Europe is clinically using S100 calcium-binding protein. These show promise for ruling out intracranial bleeds and structural damage to reduce the use of CTs in the emergency room. At this time, none of these tests has a role in the diagnosis or treatment of SRC.

Use of Biomarkers of Concussion

- There is current recommendation for genetic testing in the evaluation and management of athletes with SRC.
- Additional research is needed to determine how genetic factors influence risk of injury, time course and recovery after SRC.

Clinical Profiles

- Although SRC may present with symptoms representing only one clinical profile, SRC usually presents with symptoms and impairment supporting multiple profiles.
- Clinical profiles may be more applicable to athletes with persistent symptoms.


General Recommendations:
monitor for exacerbation of pre-existing conditions,
counsel regarding expectation of recovery,
sleep hygiene,
sub-symptom threshold aerobic exercise
Vestibular
Physical Exam
Impaired balance/gait
Abnormal vestibular-ocular reflex
Abnormal visual motion sensitivity
or other abnormal vestibular testing
Targeted treatment
Graded exposure to stimuli
Vestibular rehabilitation
Ocular
Physical Exam
Abnormal near point convergence;
Impaired accommodation
Abnormal pursuits
Abnormal saccades
Symptom provocation with above tests
Targeted treatment
Ocular rehabilitation
Lens changes
Cognitive
Physical Exam
Normal
Confusion
Disorientation
Poor performance on in-office cognitive testing
Targeted treatment
Academic modifications
Formal neurocognitive
evaluation/rehabilitation
Balance problems
Dizziness
Feeling like "in a fog"
Difficulty
remembering
"Don't feel right"
Blurred vision
Nausea or vomiting
Difficulty concentrating
Concussion Symptoms
from SCAT Symptom Evaluation
Confusion
Sensitivity to light
Feeling slowed down
Headache
Nervous or anxious
Fatigue or low energy
Neck Pain
Drowsiness
Headache-Migraine
Physical Exam
Normal
Avoidance reaction to bright light
Occipital tenderness
Neck tenderness
Tight neck muscles
Targeted treatment
Manual therapy
Treatment of HA disorder
Sensitivity
to noise
Irritability
"Pressure in head"
Trouble falling asleep
Fatigue
Physical Exam
Normal
Tired or subdued appearance
Decreased arousal
Somnolence
Targeted treatment
Cognitive behavioral therapy
Graded exertional tolerance
training in chronic setting
Sadness
More emotional
Anxiety-Mood
Physical Exam
Normal
Agitated
Anxious
Flat affect
Tearful
Targeted treatment
Maintain social engagement
Mental health counseling
Cognitive behavioral therapy

Management of Concussion

- Adolescents and adults – typically return to preinjury levels of clinical function within 2 weeks
- Pre-adolescent athletes- return to preinjury levels of function within 4 weeks
- It is important to communicate the usual time course and outcome to patients and families to relieve the anxiety and set realistic expectations.

Predicting Recovery

- Depression and subacute headache are risk factors for symptoms persisting for >1 month.
- A preinjury history of mental health issues, particularly depression, appears to increase the risk for prolonged symptoms.
- Athletes with learning disabilities or attention deficit/hyperactivity disorder do not appear to be at risk for prolonged recovery.
- New data suggests that a lower symptom-limited heart rate threshold during graded exercise testing within a week of SRC in adolescents predicts a longer recovery time.

Prescribed Rest

- In human studies, strict rest after SRC slowed recovery and led to an increased chance of symptom prolongation.
- Consensus guidelines endorse 24-48 hours of symptom-limited cognitive and physical rest followed by a gradual increase in activity, staying below the threshold of symptom-exacerbation.

Activity and Exercise

- Exercise intolerance is an objective physiological sign of acute concussion that appears to reflect impaired autonomic function and control of cerebral blood flow
- There is some preliminary evidence that subsymptom threshold exercise improves recovery in acute concussion, and early symptom-limited graded exercise testing appears to be safe in athletes

Role of Nutraceuticals

- There is no evidence in human trials that nutraceuticals prevent or relieve symptoms in SRC.
- Supplements are not FDA-regulated and potential harm or contamination should be considered that may affect recovery or eligibility.

Persistent Post Concussive Symptoms

- The new preferred term is Persistent Post Concussive Symptoms (PPCS) which is defined as symptoms that persist beyond the expected recovery time course (>2 weeks in adults, >4 weeks in children).
- Persistent symptoms do not necessarily represent ongoing concussive injury to the brain. Often symptoms may be inappropriately or mistakenly attributed to concussion from pre-existing or co-morbid conditions in PPCS.

Exercise for Persistent Post Concussive Symptoms

- The Buffalo Concussion Exercise Treatment Protocol, a progressive subsymptom threshold aerobic exercise program based on systematically establishing the level of exercise tolerance on the Buffalo Concussion Treadmill Test, is the most studied controlled exercise program.

Return to Learn

- SRC can induce changes in attention, cognitive processing speed, learning, short-term memory and executive function that make learning difficult.
- A RTL program should be established to aid in return to the classroom ideally by a multi-disciplined team.
- The RTL program should be successfully completed before the execution of a RTP plan.

Table 4
Return to learn

Facilitate communication and transition back to school.

- Notify school personnel after injury to prepare for return to school.
    - Obtain consent for communication between medical and school teams.
- Designate point person to monitor the student's status related to academics, recovery and coping with injury, and communicate with medical team.
    - School health professional, guidance counsellor, administrator, athletic trainer.
- Develop plan for missed assignments and exams.
- Adjust schedule to accommodate reduced or modified attendance if needed.

Table 4
Return to learn

Classroom adjustments	School environment adjustments
• Breaks as needed during school day.	• Allow use of headphones/ear plugs to reduce noise sensitivity.
• Reduce inclass assignments and homework.	• Allow use of sunglasses/hat to reduce light sensitivity.
• Allow increased time for completion of assignments and testing.	• Limit use of electronic screens or adjust screen settings, including font size, as needed.
• Delay exams until student is adequately prepared and symptoms do not interfere with testing.	• Allow student to leave class early to avoid crowded hallways.
• Allow testing in a separate, distraction-free environment.	• Avoid busy, crowded or noisy environments—music room, hallways, lunch room, vocational classes, assemblies.
• Modify due dates or requirements for major projects.	
• Provide preprinted notes or allow peer notetaker.	
• Avoid high-risk or strenuous physical activity.	

Return to Play

- RTP has not changed since the initial CISG's Summary and Agreement Statement of the First International Conference on Concussion in Sport, Vienna 2001.
- Its use continues to be controversial, though recommended in consensus, for lack of scientific study and debate over consideration of combination of steps.

Table 5
Return to sport

Stage	Description	Objective
1	Symptom-limited activity	Reintroduction of normal activities of daily living. Symptoms should not worsen with activity.
2	Light aerobic exercise	Walking, stationary biking, controlled activities that increase heart rate.
3	Sport-specific exercise	Running, skating or other sport-specific aerobic exercise avoiding risk of head impact.
4	Non-contact training drills	Sport-specific, non-contact training drills that involve increased coordination and thinking. Progressive introduction of resistance training.
5	Full contact practice	Return to normal training activities. Assess psychological readiness.
6	Return to sport	

Table 5

Return to sport

- Return-to-sport progressions should be individualised based on the injury, athlete's age, history and level of play, and the ability to provide close supervision during the return to activity, and progressions may vary between athletes. Each stage is generally 24 hours without return of concussion symptoms. Consider written clearance from a healthcare professional before return to sport as directed by local laws and regulations.[3]

Return to Driving

- Driving is a complex process involving coordination of cognitive, visual and motor skills, as well as concentration, attention, visual perception, insight and memory, which can all be affected by SRC.
- There is little data concerning the risk of driving after SRC, but preliminary evidence suggests some impairment exists when SRC patients report they are asymptomatic.
- It should be remembered that the adolescent SRC population are often inexperienced drivers.

Short Term Risks of Continued Exposure After Concussion or Premature Return to Play

- Increased risk of repeat concussion
- Increased rate of musculoskeletal injury
- ‘Second Impact Syndrome’
- Symptom prolongation

Long-term Risks After Concussion:
Mental Health Problems and Depression

- Mental health issues are common, multifactorial and often present independent of participation in contact or collision sport.
- Long term research on contact sport athletes that addresses multiple variables is needed to understand the long-term risks associated with mental health problems, specifically depression.

Chronic Traumatic Encephalopathy (CTE)

- The most widely described risk factor to date is extensive exposure to *both* multiple concussions and repetitive head impacts, but the threshold of necessary exposure is probably specific to the individual and subject to multiple modifying risk factors.
- Athletes and former athletes who present with neuropsychiatric signs and symptoms that have been attributed to CTE should be evaluated for potentially treatable comorbid conditions that share symptoms and should not be assumed to have CTE.

Repetitive Head Impacts

- Although sub-concussive impacts have been associated with CTE, the short-term and long-term effects of repetitive head impacts, similar to SRC, cannot be accurately characterized using current available technology.

Disqualification From Sport

- Considerations for retirement from sport include the length of concussion recovery (progressively longer time to achieve symptom resolution), development of concussion with less forceful impacts, increased severity of concussions, as well as the athlete's readiness or apprehension regarding return to sport.
- Additional contradictions for continued participation may include behavioral changes, post-traumatic seizures, persistent neurological deficit or imaging findings suggesting co-morbid or other pathology.

Prevention

- Rule changes, enforcement of existing rules, technique changes, neck strengthening and equipment modifications have been the primary focus of prevention.
- There is moderate evidence that delaying the introduction of body checking in youth hockey reduces concussion rates.
- The effectiveness of rule changes in youth soccer and football to reduce concussion incidence is not clear; however, initial evidence is showing that practice modification (i.e. decreasing tackling to ground days) and changes in tackling technique may reduce injury.
- Some football helmet designs have improved the ability to absorb force, but it has not been proven if it will reduce concussion rates.

Future Research Directions

- Epidemiological studies are needed in younger athletes, recreational activities, non-traditional sports and non-school sponsored team sports (travel, club, recreational).
- Continued study of high school, college and professional athletes to better understand concussion rates, repetitive head impact exposure, mechanisms, recovery patterns, risk factors and the success of specific intervention and prevention strategies.

Future Research Directions

- Research regarding objective tests, including neuroimaging and fluid biomarkers, to determine their diagnostic and prognostic utility.
- Research regarding specific factors or modifiers that are associated with prolonged recovery.
- Investigation into the utility of clinical profiles/concussion domains for diagnosis and treatment of SRC.
- Research the role of nutraceuticals in the prevention and treatment of acute concussion and for those with prolonged symptoms.

Future Research Directions

- The role of aerobic exercise, physical therapy (treatment of associated injuries such as cervical, ocular, and vestibular abnormalities) and psychological therapy in the treatment of SRC.
- Advanced studies to increase understanding of neurobiological effects and recovery after SRC.
- Development of evidence –based return-to-learn and return-to-sport programs.

Future Research Directions

- Exploration of the potential long-term effects of SRC and repetitive sub-concussive impacts on neurological health via prospective longitudinal studies and laboratory research.
- The role of genetic susceptibility to acute and chronic effects of SRC and sub-concussive impacts.
- Further development and implementation of primary and secondary prevention measures.

2019 Concussion Clinical Pearls

Ocular Symptoms

- Ocular
  - Ability of ocular system to work appropriately
  - Are vergence and divergence, smooth pursuits, saccades, accommodation, convergence, vestibulo-ocular reflex (VOR) and visual motion sensitivity (VMS) appropriate?

Ocular Symptoms

- May be pre-existing
- Prescreening Questions:
  - When you read pre-concussion, do you skip words?
  - When you read pre-concussion, do you lose your place?
  - When you read pre-concussion, do you get eye strain or headaches?
  - When you read pre-concussion, if distracted, are you able to find your place again?

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

Ocular Recognition and 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

Ocular Recognition and Treatment

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

Mood Recognition and Treatment

- Anxiety and Depression may show itself in concussion course as early as within 7 to 10 days
- Regardless of comfort level, it is imperative to report these findings, along with physical findings, to parents/guardians to begin immediate treatment with psychology or psychiatry and set up realistic expectations as to complication on time course of recovery.

Mood Recognition and 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

Mood Recognition and 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

Mood Recognition and Treatment

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

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Thank You

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