SPORTS RELATED CONCUSSIONS: EVALUATION, MANAGEMENT, AND FOLLOW UP

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LEARNING OBJECTIVES

- Define Sports Related Concussion
- Be able to recognize common signs and symptoms of concussions
- Be able to initiate proper post injury recovery protocol
- Be able to give evidence based education and guidance on SRC and recovery
- · Be able to implement a safe evidence based return to play protocol
- Be able to understand importance of vestibular symptoms to SRC's and proper testing
- Learn some physical therapy modalities that may aid in the recovery from SRC with short demonstration.
- Learn proper referral protocol

SPORTS RELATED CONCUSSIONS (SRC) UNDER THE MICROSCOPE

- Tremendous media attention
- Legislative review and action
- Increase in litigious cases involving coaches, ATC's and doctors
- Sports bodies under pressure to ensure appropriate surveillance



CONSENSUS STATEMENT ON CONCUSSION IN SPORT

1st Vienna 2001

2nd Prague 2004

3rd Zurich 2008

4th Zurich 2012

5th Berlin 2016

" Aim was to provide recommendations for the improvement of safety and health of athletes who suffer concussions" Consensus Statement on Concussion in Sport: The 5th International Conference on Concussion in Sport Held in Berlin

- Recognize
- Remove
- Re-evaluate
- Rest
- Rehabilitation
- Refer

- Recovery
- Return to Sport
- Reconsider
- Residual Effects and Sequelae
- Risk Reduction

Consensus Statement on Concussion in Sport:

The 5th International Conference on Concussion in Sport Held in Berlin

SPORTS RELATED CONCUSSION (SRC): DEFINITION RECOGNIZE

- Sport related concussion is a traumatic brain injury induced by biomechanical forces
 - SRC may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head.
- SRC typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, signs and symptoms evolve over a number of minutes to hours.
- SRC may result in neuropathological changes, but the acute clinical signs and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies.
- SRC results in a range of clinical signs and symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive features typically follows a sequential course. However, in some cases symptoms may be prolonged.
- The clinical signs and symptoms cannot be explained by drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction, etc) or other comorbidities (eg, psychological factors or coexisting medical conditions

Consensus Statement on Concussion in Sport:

The 5th International Conference on Concussion in Sport Held in Berlin

SPORTS RELATED CONCUSSION (SRC): DEFINITION RECOGNIZE

- "Impulsive" force to brain caused by direct blow to head, face, neck or elsewhere
- Rapid onset of short lived neurologic impairment resolves spontaneously
- Symptoms represent more a functional disturbance than structural injury, +/- LOC
- Normal imaging studies
- Clinical symptoms cannot be explained by any other means

SPORTS RELATED CONCUSSIONS NEUROPHYSIOLOGY

- •Microscopic / Chemical changes:
- cell membrane stability
- ion channels
- glucose metabolism
- neuron depolarization
- free radical production



- No perfect test or clinical marker that clinicians can rely on for immediate diagnosis of SRC in the sporting environment.
 - *Evolving injury in the acute phase, with rapidly changing clinical signs and symptoms.
 - The majority of SRCs occur without loss of consciousness or frank neurological signs.
 - In all suspected cases of concussion, the individual should be removed from the playing field and assessed by a physician or licensed healthcare provider (Varies by state).

- Sideline evaluation of cognitive function is an essential component in the assessment of this injury.
 - An initial baseline evaluation including a symptom checklist, cognitive evaluation and balance assessment has been considered 'best practice' for all athletes by the National Collegiate Athletic Association
- Brief neuropsychological (NP) test batteries that assess attention and memory function have been shown to be practical and effective
 - SCAT5, Maddock's Questions, Standardized Assessment of Concussion (SAC)
 - Standard Orientation questions (Person, Place, Time) are unreliable in the athletic setting.
- Key concept in sideline assessment is the rapid screening for a suspected SRC, rather than the definitive diagnosis of head injury
 - If SRC suspected then a more thorough diagnostic evaluation, which should be performed in a distraction-free environment (eg, locker room, medical room) rather than on the sideline.

SCAT5

IMMEDIATE OR ON-FIELD ASSESSMENT

The following elements should be assessed for all ethietes who are suspected of having a concussion prior to proceeding to the neurocognitive assessment and ideally about to done on-field efter the first first aid / emergency care prior first are completed.

If any of the "Red Flags" or observable signs are noted after a Sirect or indirect blow to the head, the advises should be immediately and advisy removed from participation and evaluated by a physician or licensed headbcare professional.

Consideration of transportation to a medical facility should be at the discretion of the physician or licensed healthcare professional.

The GCS is important as a standard measure for all patients and can be done satially if necessary in the event of datationation in conscious state. The Meddodka questions and dervicel spine exam set bitfold attaps of the immediate assessment; however, these do not need to be done serially.

STEP 1: RED FLAGS

RED 7	LAGS:
Heck pain or tandemess Double vision Westmess or Ungling/ burning in arms or lege Severe or increasing headache	Seizure or convulsion Loss of consciousness Deteriorating conscious state Voniting Increasingly restless, aglisted or combative

STEP 2: OBSERVABLE SIGNS

Witnessed II Observed on Video II.		
Lating methodies and the playing surface	Ŧ	
Balance / pet difficulties / noter incoordination: etcrisibilg.size / Telescond momente	*	
Differentiation or confluence, or an institley to respond appropriately to quantum	×	
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Faciled to any effect hand to area	v	

STEP 3: MEMORY ASSESSMENT MADDOCKS QUESTIONS²

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Mails V for secred annexy / II for Incortant		
What we us are we at today?	¥	
what had a boot		
Who assessed last in this restall?	×	×
What learn did you play last week / game?	. ¥	-
(in) your teach who the last game?	¥.	1

nok	
Address:	
ID number:	
Examiner	

STEP 4: EXAMINATION GLASGOW COMA SCALE (GCS)³

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happing-fala words			
Confident		4	
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No mater response		1	
Extension to pain	3	- 1	- #
Abnormal flasher to pain	x		.8
Fielder, Withdramethic path			. 4
Localizes to path	\$	5	: 5
These comments	100	100	

Blangere Corransors (K+Y+M)

CERVICAL SPINE ASSESSMENT

Does the addete-report that they recisite pair line at rest?

If there is NO seek pate streat, does the atlants have a full

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed until proven otherwise.

is the limit strength and sensation named?

Transmission Process

¥ 8

7 8

OFFICE OR OFF-FIELD ASSESSMEN	Т		
Please note that the neurocognitive assessment at	hould be d	lone in a	Name:
distraction-free environment with the athlete is a re	ating stat	*	DOB.
STEP 1. ATHLETE BACKGROUND			Address.
			ID mumber
Sport / team / school:		-	Examiner
Date / time of Injury:			Debe:
Years of education completed			_
Age			2
Gender: M / F / Other			0750 Q. C
Dominent hendi left / neither / right			STEP 2: 5
How many diagnosisd concussions has the stillets had in the part?			The attribute should be paragraph and loost to the attribute should be the part type? assesses
When was the most repart concussion?		6	Please Check:
	1.1		1
rrow rong was the recovery (time to being cleared to) from the most recent concussion?		(dens)	
		-1-24-2	
Has the athlete ever been:			Hashola
	140	1222	"Personal feed"
reduceded on event stark.			Ned Fall
lagional / twated for headache disorder or migraines?	Ves	No	Reason in working
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YMPTOM EVALUATION Prespitațiere faire and animal to lead this teatlocites della Prespitation aculte. Nor the Canadity astronomic est apropriore hannel est han hershe typically finete and for catilities abculd also Rest sprigitures at the posterior to the D Baseline D Post-Indary lease hard the form to the athlete rane odd modeste erers. 8 1 2 8 4 5 5 0 1 2 3 4 5 5 . 3 7 2 8 4 5 5 3 1 3 8 4 5 8 . with the -4(53) pet works with provided authors," Y H principal with transfer with the both rantial what Please hand form back to examiner

E l'anneche in Genet Caren 2017

Concussion in Sport Group 2013

SPORTS RELATED CONCUSSION SIDELINE TESTING

STEP 1: RED FLAGS

RED FLAGS:

- Neck pain or tenderness
- Double vision
- Weakness or tingling/ burning in arms or legs
- Severe or increasing headache

- Seizure or convulsion
- Loss of consciousness
- Deteriorating conscious state
- Vomiting
- Increasingly restless, agitated or combative

STEP 2: OBSERVABLE SIGNS

Witnessed Observed on Video		
Lying motionless on the playing surface	Y	N
Balance / gait difficulties / motor incoordination: stumbling, slow / laboured movements	Y	N
Disorientation or confusion, or an inability to respond appropriately to questions	Y	N
Blank or vacant look	Y	N
Facial injury after head trauma	Y	N

SPORT CONCUSSION ASSESSMENT TOOL - 5TH EDITION SCAT5 SPORT CONCUSSION ASSESSMENT TOO DEVELOPED BY THE CONCUSSION IN SPORT GROUP FOR USE BY MEDICAL PROFESSIONALS ONLY supported by **D** FIFA ??? 🖤 🎢 EI

STEP 3: MEMORY ASSESSMENT MADDOCKS QUESTIONS²

"I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?"

Mark Y for correct answer / N for incorrect

What venue are we at today?	Y	Ν
Which half is it now?	Y	Ν
Who scored last in this match?	Y	Ν
What team did you play last week / game?	Y	Ν
Did your team win the last game?	Y	Ν

Note: Appropriate sport-specific questions may be substituted.

STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read this instruction paragraph out loud then complete the symptom scale. For the baseline assessment, the athlete should rate his/her symptoms based on how he/she typically feels and for the post injury assessment the athlete should rate their symptoms at this point in time.

Please Check:
Baseline
Post-Injury

Please hand the form to the athlete

none mild					erate	sev	ere
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	з	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6
Trouble falling asleep (if applicable)	0	1	2	3	4	5	6
Total number of symptoms:						0	of 22
Symptom severity score:						of	132
Do your symptoms get worse with	h physic	al activ	vity?			Y N	
Do your symptoms get worse with	n menta	l activi	ty?			Y N	
If 100% is feeling perfectly norma percent of normal do you feel?	l, what						
,,							

If not 100%, why?

STEP 3: COGNITIVE SCREENING

Standardised Assessment of Concussion (SAC)⁴

ORIENTATION

What month is it?	0	1
What is the date today?	0	1
What is the day of the week?	0	1
What year is it?	0	1
What time is it right now? (within 1 hour)	0	1
Orientation score		of 5

MONTHS IN REVERSE ORDER

Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say December, November. Go ahead.

1

of 1

of 5

C	Dec - Nov - Oct - Sept - Aug - Jul - Jun - May - Apr - Mar - Feb - Jan
	Months Score
	Concentration Total Score (Digits + Months)

IMMEDIATE MEMORY

The Immediate Memory component can be completed using the traditional 5-word per trial list or optionally using 10-words per trial to minimise any ceiling effect. All 3 trials must be administered irrespective of the number correct on the first trial. Administer at the rate of one word per second.

Please choose EITHER the 5 or 10 word list groups and circle the specific word list chosen for this test.

I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order. For Trials 2 & 3: I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.

liet		Alte		S	core (of	5)		
List		Ante	mate 5 word	mata		Trial 1	Trial 2	Trial 3
A	Finger	Penny	Blanket	Lemon	Insect			
в	Candle	Paper	Sugar	Sandwich	Wagon			
С	Baby	Monkey	Perfume	Sunset	Iron			
D	Elbow	Apple	Carpet	Saddle	Bubble			
E	Jacket	Arrow	Pepper	Cotton	Movie			
F	Dollar	Honey	Mirror	Saddle	Anchor			
			Im	mediate Mem	ory Score			of 15

Time that last trial was completed

CONCENTRATION

DIGITS BACKWARDS

Please circle the Digit list chosen (A, B, C, D, E, F). Administer at the rate of one digit per second reading DOWN the selected column.

I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7.

Concentra	tion Number Lis	ts (circle one)			
List A	List B	List C			
4-9-3	5-2-6	1-4-2	Y	N	0
6-2-9	4-1-5	6-5-8	Y	N	1
3-8-1-4	1-7-9-5	6-8-3-1	Y	N	0
3-2-7-9	4-9-6-8	3-4-8-1	Y	N	1
6-2-9-7-1	4-8-5-2-7	4-9-1-5-3	Y	N	0
1-5-2-8-6	6-1-8-4-3	6-8-2-5-1	Y	Ν	1
7-1-8-4-6-2	8-3-1-9-6-4	3-7-6-5-1-9	Y	N	0
5-3-9-1-4-8	7-2-4-8-5-6	9-2-6-5-1-4	Y	N	1

STEP 5: DELAYED RECALL:

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section. Score 1 pt. for each correct response.

Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you can remember in any order.



of 5 or

of 10

Total number of words recalled accurately:

SIDELINE TESTING: BESS

BALANCE EXAMINATION

Modified Balance Error Scoring System (mBESS) testing⁵

Which foot was tested	□ Left	
(i.e. which is the non-dominant foot)		
Testing surface (hard floor, field, etc.)		
Footwear (shoes, barefoot, braces, tape, etc.)		
Condition	Errors	
Double leg stance	of 10	
Single leg stance (non-dominant foot)	of 10	
Tandem stance (non-dominant foot at the back)	of 10	
Total Errors	of 30	

SPORTS RELATED CONCUSSION SIDELINE TESTING



	a fair and a second
	Namec
	DOB:
	Address:
	ID number:
	Examinar:
	Date:
	CONCENTRATION
	DIGITS BACKWARDS
2	Please circle the Digit list chosen (A, B, C, D, E, F). Administer at the rate of one digit per second reading DDWN the selected column.
-	I am going to read a string of numbers and when I am done, you repeat them back to me in memory other of how I used them to you. For example, if I any 32-5, you would say 3-1-7.

Concerns	dies Number Lie	ta (citale ane)			
ListA	List®	Lier C			
4-9-0	5-2-6	144-2	τ.	N	
60.0	4-5-5	664	۲		
2-8-1-6	1-7-9-5	649-3-1	*	N	
3-3-3-4	44-6-8	3-6441	Ψ.		
6-3-9-7-1	4-8-5-2-7	441-5-2	×.		
15044	6-1-8-4-3	640-51	¥		
718462	8-2-1-9-6-6	334414	*		
5-0-9-1-0-8	704856	934-514	Ψ.		
1887D	LietE	Ue:F			
7-8-2	3-8-2	2-7-1	۲		
4-3-6	514	6-7-9	¥.	н	
4-1-8-2	2-7-4-3	1-6-8-2	Ψ.		
97.5-9	24-5-9	3494	Υ.		
1-7-9-3-6	6-1-8-6-9	2-67-54	×.		
61-7-5-2	9-4-1-3-5	8-3-9-6-1			
24-4-8-1-7	647342	584-2-69	Ψ.	н	
244444	8-2-7-9-3-8	\$15406	۲		
			-		

MONTHS IN REVERSE ORDER

Now tell the the months of the year in reverse artist. Start with the last month and y . So you'll say December, November, Bo ahead.	pe dasci want.
Dec - Nav - Oct - Sept - Aug - Jul - Jut - May - Apr - Mar - Feb - Jan	01
Months Score	aff
Cancentration Tetal Score (Dight - Mantha)	at5

STEP 4: NEUROLOGICAL SCREEN See the instruction sheet (page 7) for details of

Can the patient read aloud (e.g. symptom check- list) and follow instructions without difficulty?	w.	
Down the partient have a full range of pain- tree PASSIVE cervical spine requesternt?	¥	
Without moving their head or neck, can the partient look side-to-side and up-and-down without double vision?	Ψ.	- 14
Can the patient perform the linger nose coordination text normally ¹	Ψ.	
Can the patient perform tandem gait normally?	Ψ.	- 54

BALANCE EXAMINATION

Which foot was tested (i.e. which is the non-dominant fout)	a tout)		
Testing surface (hant floor, field, etc.)			
Foorwear (shares, banefact, braces, tape, etc.)			
Cundisan	Erran		
Deuble leg stance	of 11		
Eingle leg stance (non-duminant foot)	if he		
Tandem stance (val-dominant feat at the back)	atti		
Tetal Errers	a/ 3		

6

STEP 6: DECISION

	Date	à time el assesso	wit:	Date and time
Domain Symptom number (p152)				If the athlete is D the D No (If different, d
Symptom severity accere(pf 192)				D Yes D No
Orientation (of S)				D Yes D No
Introduce memory	of 15 al 30	af 15 of 20	af 15 67.30	l am a physi administer
Concentration (of S)	1			Signature:
Neuro exam	Normal Abnormal	Normal Abnormal	Namul Absorbal	Name:
Balance errors (pl 30)				Title:
Delayed Recall	afS af10	at S of 10	af 5 af 10	Registratio

Date and time of injury:
If the athlete is known to you prior to their injury, are they different from their usual sel
D Yes D No D Meare D Hat Applicable
(If different, describe why in the clinical name section)
Concusation Disgnosed?
D'ites D No D tineare D'hist Applicable
If re-testing, has the athlete improved?
D Yes D No D Meure D Nat Applicable
I am a physician or licensed healthcare professional and I have personal administered or supervised the administration of this SCATS.
Signature:
Name:
Tele:
Registration number (if applicable):
Barbel

SCORING ON THE SCAT5 SHOULD NOT BE USED AS A STAND-A METHOD TO DIAGNOSE CONCUSSION, MEASURE RECOVERY MAKE DECISIONS ABOUT AN ATHLETE'S READINESS TO RETUR COMPETITION AFTER CONCUSSION.

	CLINICAL NUTES.	
ame:		Name:
OB:		DOB:
édreas:		Address:
number:		ID number:
aminer:		Examiner:
nter		Date:
- C		
r -	÷	
EP 5: DELAYED RECALL	*6 	
delayed recall should be performed after 5 minutes have used since the end of the Immediate Recall section. Score 1 for each comect response.		
ou momentain that fait of words i mud a few times earlier? Tell me as many words the fair as you can remember in any order.		
Time Started		
er moant wart correctly recalled. Total scare equals number of words recalled.		
		:
and and an advantage of the second seco		
and number of words recalled accurately: arts of arts		
t time of injury:	CONCUSSION INJURY ADVICE (To be given to the person monitoring the concussed athlete)	Clinic phone number:
ne is known to you prior to their injury, are they different from their asual self? No II Unsure II Not Applicable	This patient has received an injury to the head. A careful medical	Patient's name:
n, describe why in the clinical name section)	complications has been found. Recovery time is variable across	Date / time of injury:
an Disgnosed?	individuals and the patient will need monitoring for a further pe- ried by a responsible adult. Your treating obvisions will provide	
	guidance as to this timeframe.	Date / time of medical review:
No D Meure D Not Applicable	If you notice any change in behaviour vomiting, worsening head-	Healthcare Provider:
typician or licensed healthcare professional and I have personally tered or supervised the administration of this SCATS.	ache, double vision or excessive drowsiness, please telephone your doctor or the nearest hospital emergency department immediately.	
e	Other important points:	
	Initial rest: Limit physical activity to routine daily activities (aunid	
tion number (if applicable):	exercise, training, sports) and limit activities such as school,	
1.0000 M20	work, and screen time to a level that does not worsen symptoms.	
	1) Avoid alcohol	
	 Avoid prescription or non-prescription drugs without medical supervision. Specifically: 	Concussion in Sport Group 2017
	a) Avoid sleeping tablets	
E USED AS A STAND-ALONE , MEASURE RECOVERY OR	b) Do not use aspirin, anti-inflammatory medication or stronger pain medications such as narcotics	
READINESS TO RETURN TO	3) Do not drive until cleared by a healthcare professional.	
UNCUSSION.	4) Return to play/sport requires clearance	
	by a healthcare professional.	Contact dataile or etamo

CUMICAL MOTEC

SPORTS RELATED CONCUSSIONS COMMON SIGNS

- dazed, stunned appearance
- *confusion: assignment/position
- moves clumsily
- answers questions slowly
- mood, behavior, personality changes
- amnesia



SPORTS RELATED CONCUSSIONS COMMON SYMPTOMS

- Headache, pressure in head
- Nausea, vomiting
- Dizziness, balance problems
- Blurred vision, photosensitivity
- Difficulty concentrating
- Feels "down", groggy, foggy



SPORTS RELATED CONCUSSIONS REMOVE

- Any of the above signs and symptoms then remove
 - When in doubt sit them out (Err on the side of caution)
- The player should not be left alone after the injury, and serial monitoring for deterioration is essential over the initial few hours after injury.
- A player with diagnosed SRC, or suspected of having SRC, should not be allowed to return to play on the day of injury.

KING-DEVICK TESTING



KING-DEVICK TESTING REMOVE

- The King-Devick Test is a two-minute rapid number naming assessment in which an in individual quickly reads aloud single digit numbers and evaluates impairments of eye movements, attention and language function
- Peer-reviewed research has shown that adding a vision-based performance measure to cognitive and balance testing enhances the detection capabilities of current sideline concussion assessment
- A recent meta-analysis found King-Devick Test to be both sensitive (86%) and specific (90%) for the detection of concussion. Any worsening of King-Devick Test from baseline indicated a five-times greater likelihood of concussion
- Both medical personnel and laypersons may administer the K-D test with high degrees of reliability
- When the K-D and SAC were combined, their ability to detect concussion was increased to 89%, and increased to 100% when the BESS was added

SPORTS RELATED CONCUSSIONS RE-EVALUATE

- Once diagnosed on the sideline with a SRC the athlete should then have appropriate follow up with a physician skilled in concussion evaluation and management.
 - A medical assessment including a comprehensive history and detailed neurological examination including a thorough assessment of mental status, cognitive functioning, sleep/wake disturbance, ocular function, vestibular function, gait and balance.
 - Determination of the clinical status of the patient, including whether there has been improvement or deterioration since the time of injury. This may involve seeking additional information from parents, coaches, teammates and eyewitnesses to the injury.
 - Determination of the need for emergent neuroimaging to exclude a more severe brain injury (eg, structural abnormality).

SPORTS RELATED CONCUSSIONS REST

- Physical and cognitive rest
- 24-48 hrs.
 - Patients can be encouraged to become gradually and progressively more active while staying below their cognitive and physical symptom-exacerbation thresholds
- *Rest may promote recovery by minimizing brain energy demands following concussion
- The exact amount and duration of rest is not yet well defined

SPORTS RELATED CONCUSSIONS REHABILITATION

- Return to learn
- Return to play
- Manage concurrent injuries:
 - Psychological, cervical, Vestibular
- *Controlled cognitive stress, pharmacological treatment, and school accommodations, may be beneficial.
- 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.

SPORTS RELATED CONCUSSIONS REFER: PERSISTENT SYMPTOMS

- Failure of normal clinical recovery
 - 10-14 days in adults
 - > 4 weeks in children
- Individualized to target specific medical, psychosocial, or physical symptoms
 - Individualized symptom-limited aerobic exercise program
 - Targeted PT for cevical spine and vesitbular function
 - CBT for any behavioral or mood issues

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						

VESTIBULAR SYMPTOMS SCREENING AND TREATING

- Demonstration by Chelsea Best MPT
 - Vestibular Therapist for Encore Rehabilitation in Mobile and Baldwin Counties

BUFFALO CONCUSSION TREADMILL TEST (BCTT)

Purpose:

- To investigate exercise tolerance in patients with post-concussive symptoms (PCS) lasting more than 3 weeks.
- To help establish appropriate levels of exercise to aid in Return to Play for concussed athletes and assist in treatment protocols.
- To aid in differentiating between possible diagnoses for concussive symptoms (Cervicogenic injury, PCS, etc.) and etiology of the concussion.
- To identify physiological variables associated with exacerbation of symptoms, and the patient's level of recovery.

BUFFALO CONCUSSION TREADMILL TEST TERMINATING THE TEST

Test continues until:

- Maximum exertion (RPE score of 19.5) is reported or
- Test is terminated by experimenter due to a symptom exacerbation that causes significant increase in pain or symptom severity (an increase of more than 3 points on the Likert scale from resting score, addition of several new symptoms, or marked increase in severity of symptoms resulting in difficulty continuing test) or
- Experimenter notes a rapid progression of complaints (ex. headache to searing focal pain) between symptom reports, patient appears faint or unsteady, or determines that continuing the test constitutes significant health risk for the participant, or
- Patient reports an inability to continue the test safely

BUFFALO CONCUSSION TREADMILL TEST TREATMENT/RETURN TO PLAY

- On completion of the BCTT, concussion patients may be given an exercise prescription based on 80% of the maximum heart rate reached without symptom exacerbation. Patients are instructed to exercise at this level for 20 minutes daily without exceeding the time, or heart rate constraints.
- Patients may increase heart rate by swimming, walking or stationary cycling the athlete should not attempt resistance training.
- If any post-concussion symptoms return along the progression, the athlete must return to the previous asymptomatic stage/maximum heart rate.
- If the patient can exercise to voluntary exhaustion on the BCTT without eliciting symptoms, you may begin the process of returning him/her to play by following the five- step return to play program of the Zurich Consensus Statement.
- Other prescriptions and recommendations will be based on the patient's particular complaints. A patient may be recommended for cervical physical therapy, vestibular physical therapy, infusion therapy or treatment for temporomandibular joint disorders

SPORTS RELATED CONCUSSIONS RECOVERY

- Clinical recovery is defined functionally as a return to normal activities, including school, work and sport, after injury
 - Physiological time of recovery may outlast the time for clinical recovery (May still be at increased risk)
- SRCs can have large adverse effects on cognitive functioning and balance in the first 24–72 hours after injury.
- A greater number and severity of symptoms after an SRC predict a slower recovery. (strongest evidence)
- Children, adolescents and young adults with a pre-injury history of mental health problems or migraine headaches are at a greater risk of having symptoms for more than 1 month
- Newer research 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

SPORTS RELATED CONCUSSIONS RETURN TO SPORT

- Must be asymptomatic and back in school full time.
- Gradual Step-wise rehabilitation strategy
- 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.

SPORTS RELATED CONCUSSIONS RETURN TO SPORT

Graduated Return to Sport Strategy

Exercise step	Functional exercise at each step	Goal of each step
1. Symptom- limited activity	Daily activities that do not provoke symptoms.	Gradual reintroduc- tion 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, e.g., passing drills. May start progressive resistance training.	Exercise, coor- dination, and increased thinking.
5. Full contact practice	Following medical clear- ance, participate in normal training activities.	Restore confi- dence and assess functional skills by coaching staff.
6. Return to play/sport	Normal game play.	

SPORTS RELATED CONCUSSIONS RETURN TO LEARN

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

SPORTS RELATED CONCUSSIONS RECONSIDER

- Special populations:
 - Elite vs Non-elite athletes
 - Should follow same guidelines and management protocols
 - Children and adolescents
 - Expected recovery time line is 4 weeks
 - Students should have regular follow-up to monitor recovery and help with return to school, and may require temporary absence from school after injury
 - Should not return to sport until they have successfully returned to school
 - However, early introduction of symptom-limited physical activity is appropriate

SPORTS RELATED CONCUSSIONS RESIDUAL EFFECTS AND SEQUELAE

- Long term consequences are inconclusive
- Clinicians should be mindful of potential complications such as cognitive impairment, depression and potential of developing CTE
 - Cause and effect relationship has not been established yet
 - 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
 - Athletes with significant neurological decline do not always have histopathological changes of CTE
 - The presence of histopathological changes of CTE are not always associated with neurological symptoms
 - Neurodegenerative pathological changes similar to CTE can occur naturally with the aging process

SPORTS RELATED CONCUSSIONS RISK REDUCTION

- Role of pre-participation and baseline screening
 - May identify high risk individuals with past concussions and serve as an entry point for education
 - Identify comorbid conditions that may make diagnosis more difficult
- Pre-season Concussion Education
 - An initial baseline evaluation including a symptom checklist, cognitive evaluation and balance assessment has been considered 'best practice' for all athletes by the National Collegiate Athletic Association
- Helmets and mouthguard do not prevent concussions but prevent other injuries and traumas
- Style of play (Helmet to helmet contact, limiting body checks in youth hockey)
- Neck strengthening

SPORTS RELATED CONCUSSIONS RISK REDUCTION

- USA Concussion Awareness Program: CAP
- The website: <u>www.concussionawarenessprogram.org</u>
 - Neurocognitive testing
 - Educational video
 - Pre and post-test
 - Sideline assessment tool
 - Concussion clinic information and contacts
 - Return to play and learn protocol

SPORTS RELATED CONCUSSIONS: CAP RESULTS

Risk reduction

- Results indicated statistical significance (p< .001) when all scores for the attitude based questions
- They scored higher on the post-test (M = 21.22) than the pretest (M = 19.69).
- Knowledge based questions only (N=556) indicated statistical significance (p<.001) with an increase in the scores from prior to the program (M = 4.06) to after the education program was completed (M = 4.44).
- The athletes (N=533) reached statistical significance (p<.001) with an increase in the attitude and knowledge of the post-test compared to the pretest.

EMERGING TESTS

- Helmeted and Non-Helmet Impact monitors
- Biomarkers
 - Blood, saliva, CSF
 - FDA approval of brain protein trauma indicator for ruling out intracranial bleeds (reduce CTs in ER)
 - Currently no role for genetic testing
 - ?? Genetic factors in influencing risk of injury and recovery
- Neutraceuticals
 - B-Vitamins, Omega-3-FA's, Vitamin D, N-Methyl-D-aspartate, exogenous Ketones, Magnesium, Keto-Diet
 - no human evidence that nutraceuticals prevent or ameliorate concussion in athletes

EMERGING CONCEPTS CLINICAL PROFILES



SUMMARY

- Sport related concussion is a complex, heterogeneous brain injury that typically resolves clinically in 1–4 weeks.
- The diagnosis of concussion is challenging as it relies on self-reported symptoms that can be caused by other common conditions and there are no readily available objective diagnostic tests to confirm the diagnosis. Use the tools you have to help
- When in doubt sit them out!
 - Remember this is an evolving condition
- Knowledge transfer and SRC education is increasingly valuable in management and prevention of concussions. Consider a comprehensive education and baseline testing program if resources exist
- Keep Vestibular deficits in mind for athletes who are back to normal with everything but can't tolerate full practices. Refer for therapy early
- Don't be afraid to initiate a sub-symptom threshold exercise program. Familiarize yourselves with the BCTT
- Help keep sports safe
- No harm in taking unnecessary head contact out of sports

THANK YOU!!

