

Sport Concussion



Course Outline

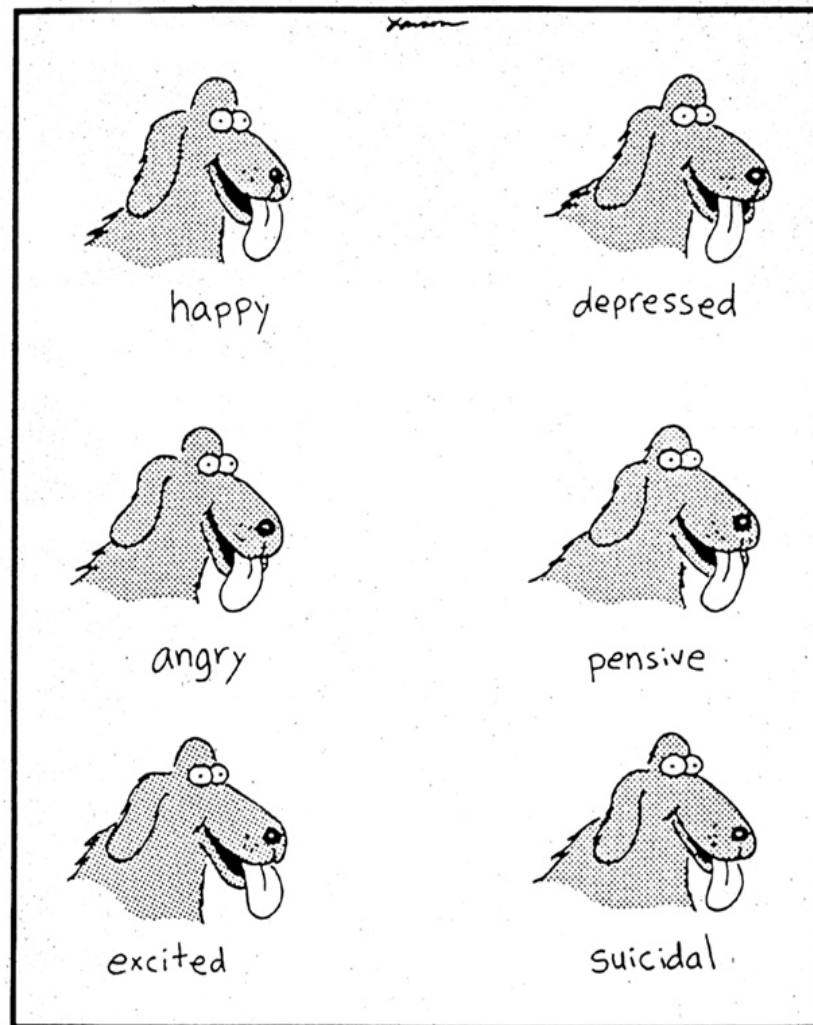
1. Introduction
2. What is a concussion?
3. How do concussions occur?
4. Signs and Symptoms?
5. How do I manage a
Concussion
6. Other Issues
7. Prevention



The Challenge of Sports Related Concussions

- Fast pace of the game.
- Athletes are reluctant to acknowledge symptoms.
- Decision can have huge implications on the outcome of the game.
- Resources available to assess the athlete are limited.
- Injuries are mild, subtle, and sometimes difficult to detect.
- Objectivity of assessment.

The Challenge of Concussions



Recovery Model

- Concussion Recovery Model vs. Orthopedic Recovery Model
- Concussions need to be managed differently than orthopedic injuries.
- “No pain. No gain.” Does not apply.

What is a Concussion?

Section 2

Definition

- “A complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces”.



Definition continued

1. *Concussion 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.*
2. *Concussion typically results in the rapid onset of short- lived impairment of neurologic function that resolves spontaneously.*
3. *Concussion may result in neuropathological changes but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury.*

Definition continued

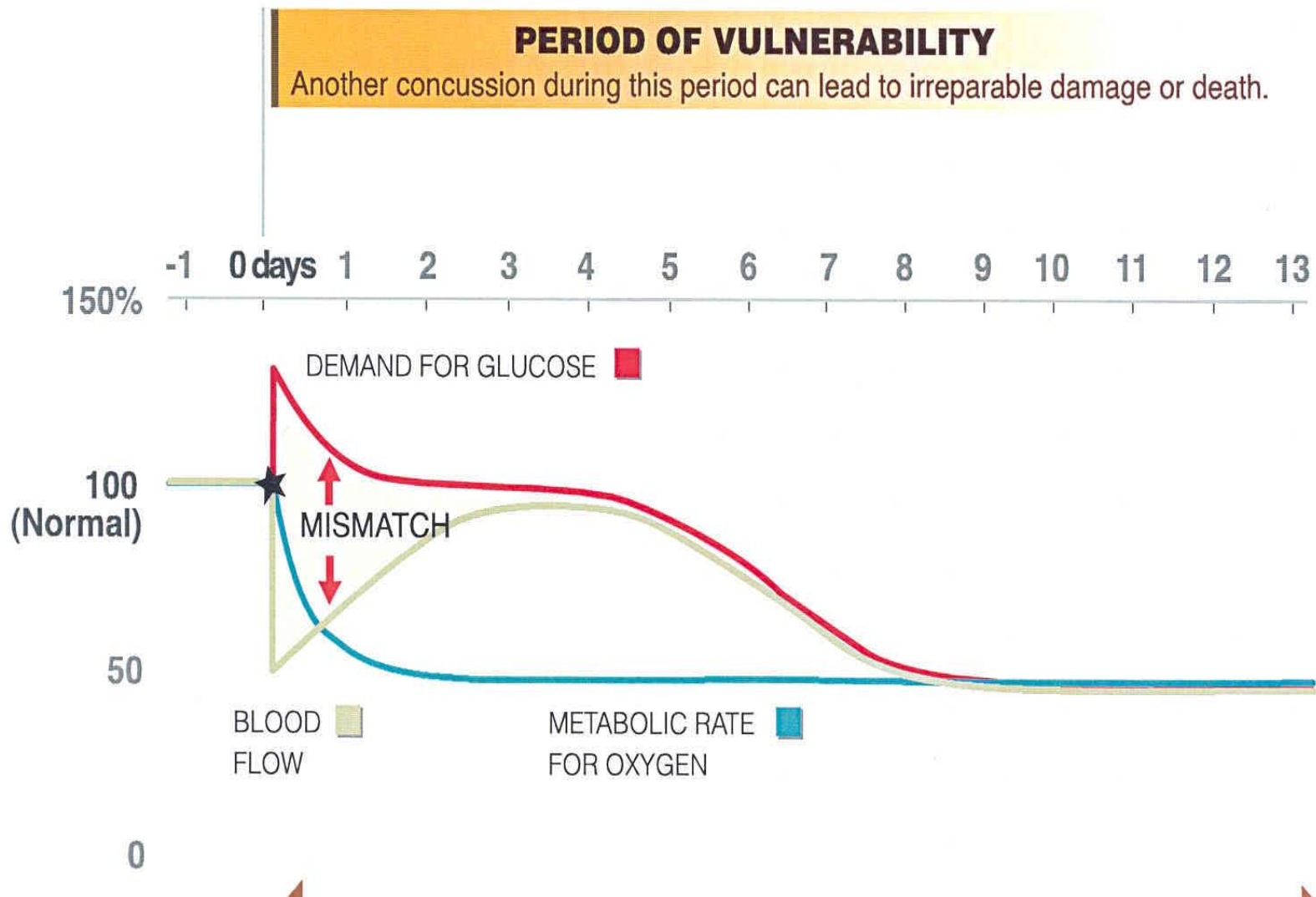
4. *Concussion results in a graded set of clinical symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course. However it is important to note that in a small percentage of cases, post-concussive symptoms may be prolonged.*
5. *No abnormality on standard structural neuroimaging studies is seen in concussion.*

Neurometabolic Changes and Concussion

- Trauma/Concussion
- Diffuse axonal injury
- Massive release of K^+ ions
- ↑ Glycolysis for K^+ pumps



Neurometabolic Changes and Concussion



How Do Concussions Occur?

Section 3

Mechanism of Injury

- When an athlete is moving at a high rate of speed and collides with another object.
- The brain shifts inside the skull and strikes the bony surfaces.

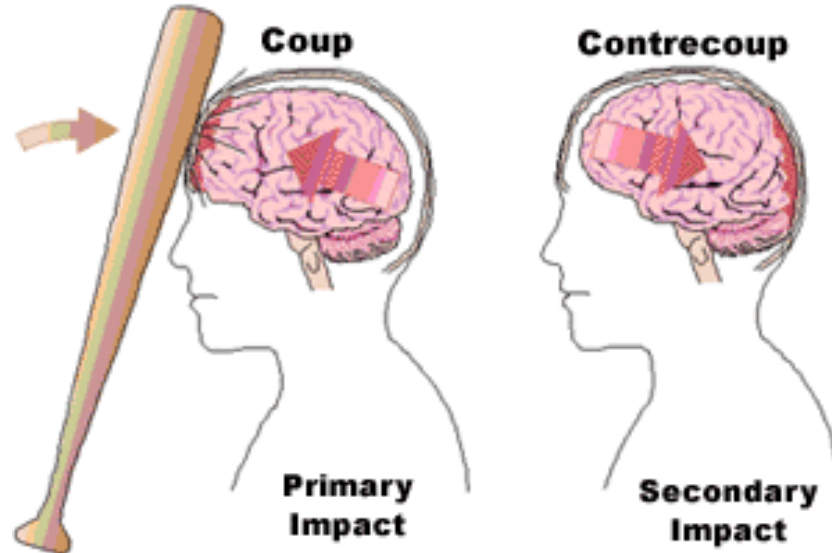


Injury Mechanics

- A direct impact to an athlete's head causes shock waves to pass through the skull to the brain.
- This impact creates acceleration.
- Acceleration can lead to shear, tensile and compressions forces.

Impact Mechanics

- A *contrecoup* injury is a result of axial rotation with acceleration, this causes an injury away from the actual impact site.



How Often Do Concussions Occur?

- On average, 3-5% of all sport and recreational injuries are head injuries.
- The majority of sport related head injuries are mild.
- The most common cause of sport related head injuries are falls.

How Often Do Concussions Occur?

- Patients younger than 20 years old are more likely to suffer a sports related head injury.
- Males are more frequently injured. These statistics are changing as more females engage in contact sports.
- Very few head injuries are hospitalized.

Recognition of Concussions

- It is common for athletes to underreport the incidence of sport concussions.
- Often athletes do not associate their symptoms with those of a concussion.

Athletic Trainers Report

- Athletic Trainers from Canada and the United States identified head injuries as 5% of their total sports injuries.

Top Causes of Concussions

Female

- Soccer
- Horseback Riding
- Cycling
- Ice Hockey
- Snowboarding

Male

- Ice Hockey
- Cycling
- Football
- Soccer
- Snowboarding



Sport Specific Rates

- Hockey: 4.9 %
- Soccer: 3.1 %
- Football: 4.97%



Sport Specific Rates

Hockey:

High School: 17.6/1000 hours

Peewee: 23.1/1000 hours

Bantam: 10.7/1000 hours

Skating:

Children under age 6 had twice the head injuries as older children.

Tae kwon Do:

Tournaments: 50/1000 injuries

Boxing:

Amateur: 7.9/1000 minutes

Rugby:

High School: 10.26/1000 hours

Signs and Symptoms

Section 4

Canadian researchers have found the first evidence that athletes who suffer concussions show mental and physical declines more than 30 years later.

- Former athletes now in their 50s, who sustained concussions playing university football and hockey, have more trouble remembering things like lists and show other symptoms that may put them at higher risk for disorders such as Alzheimer's disease, says Louis De Beaumont, who headed the study at the Centre for Neuropsychology and Cognition at the Universite de Montreal.

What's New?

- Sport Concussion Assessment Tool revision (SCAT2)
- Pocket SCAT2
- Abandon simple vs. complex terminology
- Emphasis on balance assessment
- Modifiers influencing investigation and management
- Elite vs non elite approaches (based on resources)
- Paediatric management strategy

Pocket SCAT2

Pocket SCAT2



FIFA®



Concussion should be suspected in the presence of **any one or more** of the following: symptoms (such as headache), or physical signs (such as unsteadiness), or impaired brain function (e.g. confusion) or abnormal behaviour.

1. Symptoms

Presence of any of the following signs & symptoms may suggest a concussion.

- Loss of consciousness
- Seizure or convulsion
- Amnesia
- Headache
- "Pressure in head"
- Neck Pain
- Nausea or vomiting
- Dizziness
- Blurred vision
- Balance problems
- Sensitivity to light
- Sensitivity to noise
- Feeling slowed down
- Feeling like "in a fog"
- "Don't feel right"
- Difficulty concentrating
- Difficulty remembering
- Fatigue or low energy
- Confusion
- Drowsiness
- More emotional
- Irritability
- Sadness
- Nervous or anxious

2. Memory function

Failure to answer all questions correctly may suggest a concussion.

"At what venue are we at today?"

"Which half is it now?"

"Who scored last in this game?"

"What team did you play last week / game?"

"Did your team win the last game?"

3. Balance testing

Instructions for tandem stance

"Now stand heel-to-toe with your non-dominant foot in back. Your weight should be evenly distributed across both feet. You should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

Observe the athlete for 20 seconds. If they make more than 5 errors (such as lift their hands off their hips; open their eyes; lift their forefoot or heel; step, stumble, or fall; or remain out of the start position for more than 5 seconds) then this may suggest a concussion.

Any athlete with a suspected concussion should be IMMEDIATELY REMOVED FROM PLAY, urgently assessed medically, should not be left alone and should not drive a motor vehicle.

Classification

- Abandoned the Simple vs Complex terminology
- Retained the concept that the majority (80-90%) of concussions resolve in a short (7-10 day) period
 - May be longer in children and adolescents

Signs and Symptoms

- a) Symptoms - somatic (e.g. headache), cognitive (e.g. feeling like in a fog) and/or emotional symptoms (e.g. lability)
- b) Physical signs (e.g. loss of consciousness, amnesia)
- c) Behavioural changes (e.g. irritability)
- d) Cognitive impairment (e.g. slowed reaction times)
- e) Sleep disturbance (e.g. drowsiness)

On-field or sideline evaluation of acute concussion

- The player should be medically evaluated onsite using standard emergency management principles and particular attention should be given to excluding a cervical spine injury.
- The appropriate disposition of the player must be determined by the treating healthcare provider in a timely manner.
- An assessment of the concussive injury should be made using the SCAT2 or other similar tool.
- The player should not be left alone following the injury and serial monitoring for deterioration is essential over the initial few hours following injury.
- A player with diagnosed concussion should not be allowed to return to play on the day of injury (see management section).

Investigations

- Neuroimaging (CT, MRI)
 - Contributes little to concussion evaluation
 - Use when suspicion of intracerebral structural lesion exists:
 - prolonged loss of consciousness
 - focal neurologic deficit
 - worsening symptoms
 - Deterioration in conscious state
- Newer structural and functional imaging modalities are still at early stage of development in concussion

Investigations

- Balance assessment
 - Balance error scoring system (BESS)
- Neuropsychological assessment
 - Best done after symptom resolution
 - Most sensitive when compared to baseline
- Genetic Testing
 - Significance unknown for Apolipoprotein (Apo) E4, ApoE promotor gene, Tau polymerase, other genetic and cytokine factors

How Do I Manage a Suspected Concussion?

Section 5

Management

- **CORNERSTONE = rest until asymptomatic**
 - **Rest from activity**
 - No training, playing, exercise, weights
 - Beware of exertion with activities of daily living
 - **Cognitive rest**
 - No television, extensive reading, video games?
 - Caution re: daytime sleep

REST = ABSOLUTE REST!

Sports concussion

Follow-up Management

- Rest
- Rest
- Rest
- Expect gradual resolution in 7-10 days
- Start graded exercise rehabilitation when asymptomatic at rest and post-exercise challenge

Recovery

- How long asymptomatic before exercise?
 - If rapid and full recovery, then 24-48 hours
 - One approach is to require that they remain asymptomatic (before starting exertion) for the same amount of time as it took for them to become asymptomatic.

Symptoms in Sports concussion

- Everyone “*feels fine*”
- Always ask:
 1. “*On a scale of 0 to 100%, how do you feel?*”
 2. “*what makes you not 100%?*”
 3. Checklist – SCAT2

How do you feel?

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

	none	mild			moderate		severe	
Headache	0	1	2	3	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	3	4	5	6	

Graded Exertion Protocol

Rehabilitation stage	Functional exercise at each stage of rehabilitation	Objective of each stage
1. No activity	Complete physical and cognitive rest.	Recovery
2. Light aerobic exercise	Walking, swimming or stationary cycling keeping intensity < 70% MPPHR No resistance training.	Increase HR
3. Sport-specific exercise	Skating drills in ice hockey, running drills in soccer. No head impact activities.	Add movement
4. Non-contact training drills	Progression to more complex training drills e.g. passing drills in football and ice hockey. May start progressive resistance training)	Exercise, coordination, and cognitive load
5. Full contact practice	Following medical clearance participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6. Return to play	Normal game play	

- **24 hours per step**
- **If there is recurrence of symptoms at any stage, return to previous step**

Same day return to play?

- Return to play must follow same basic management with full clinical and cognitive recovery before RPT
- Same Day?
 - Not in young (<18 years)
 - Collegiate and high school athletes show deficits with same day RTP
 - With adult athletes, in some settings, where there are team physicians experienced in concussion management and sufficient resources as well as access to immediate (i.e. sideline) neuro-cognitive assessment, return to play management may be more rapid.

Return to Play / Sport

- Must pass graded exertion first
=remain asymptomatic
- Is the athlete **confident** to go back?
- New helmet/head gear?
- Other “protective” equipment / behaviors / factors?
- Consider implications of multiple/recent injury

Management Issues

- Consider role for psychological approaches
- Pharmacotherapy
 - Prolonged symptoms (sleep disturbance, anxiety)
 - Modify underlying pathophysiology
- Upon return to play should not be on medication that could mask symptoms
 - Antidepressants?

Management Issues

- Preparticipation Evaluation History:
 - Type of sport?
 - Number of prior concussions?
 - Prior facial, dental injuries?
 - Non-sporting head injuries?
 - Type of player (“physical”?)
 - Ability to “take a hit”
 - Protective equipment (helmet age)

FACTORS	MODIFIER
Symptoms	Number Duration Severity
Signs	Prolonged LOC (>1min) Amnesia
Sequelae	Concussive convulsions
Temporal	Frequency -repeated concussion over time Timing - injuries close together "Recency" - recent concussion or TBI
Threshold	Repeated concussions occurring with progressively less impact force or slower recovery after each successive concussion
Age	Child and adolescent (< 18 years old)
Co and Pre-morbidities	Migraine, depression or other mental health disorders, attention deficit hyperactivity disorder (ADHD), learning disabilities (LD), sleep disorders
Medication	Psychoactive drugs Anticoagulants
Behaviour	Dangerous style of play
Sport	High risk activity Contact and collision sport High sporting level

Modifiers

- May influence investigation and management
- May predict potential for prolonged or persistent symptoms
- Multidisciplinary approach coordinated by a physician with specific expertise in management of concussion.

Child and Adolescent Athlete

- Adult recommendations can apply down to age 10
- Below 10 require age appropriate symptom checklists
- Include both patient and parent, teacher, etc.
- Possibly use neuropsych testing before symptoms resolve to assist planning school management

Child and Adolescent Athlete

- Consider age specific physical and cognitive rest issues
- Symptom resolution may take longer
- Consider extending symptom free period before starting return to play protocol
- Consider extending length of the graded exertion protocol
- Do not return to play same day

Elite vs non-elite

- All athletes should be managed the same regardless of level of participation
- However, available resources and expertise may facilitate a more aggressive management approach

Other Issues

Section 6

Other Issues

- Rule changes
 - Consider where clear cut mechanism is implicated
- Risk compensation
 - Use of protective equipment may change behavior
- Aggression vs violence
 - Violent behavior that increases concussion risk should be eliminated
 - Promote fair play and respect

3 Concussions

- After an athlete has sustained **3 concussions**, serious consideration should be given to removal from contact sports.
- However, each athlete should be considered on an individual basis.
- Athletes with a history of 3 or more concussions have a **slower recovery rate** than athletes with one prior concussion.

Second Mild Concussion

- What happens when an athlete suffers from a second mild concussion within the same season?
 - Current conservative mandates indicate removal from competition for at least 2 weeks.
 - Return to play should be considered only if the athlete is symptom free during rest and exertion.
 - Consultation with a physician is essential.

How Many is too Many?

- There is no magic number of how many concussions are too many.
- This must be evaluated individually.
- Return to play decisions should be guided by neuropsychological test results and symptoms reported by the athlete **regardless** of the number of concussions.

Does Age Affect Recovery Time?

- High school athletes **may** exhibit slower recovery after sports related concussions compared to collegiate athletes.



Younger Athletes

- Younger athletes are more prone to complex concussions than college athletes.
- Younger athletes show more signs of mood disturbance (irritability, lower frustration tolerance) than older athletes.

Second Impact Syndrome

- It is thought to occur when an athlete suffers a second blow to the head while recovering from an initial concussion.
- This can happen up to 14 days post injury.
- The result is a catastrophic increase in intracranial pressure which, in rare cases, can lead to death.
- It most often occurs in athletes under 21 years of age.
- This is very rare and there is still debate on when it occurs.

Prevention

Section 7

Baseline Assessment

- Complete a pre-season, baseline cognitive assessment and symptom score for each athlete.



- In the event of a concussion, compare an athlete's post-concussion symptoms to their baseline scores.

Athlete Medical History

- Obtain a medical history from each athlete to determine who is at a higher risk for a concussion.
- A player is at a greater risk if:
 - They have sustained > 1 concussion within the last year .
 - They have history of migraine headaches.
 - They have history of depression or a learning disability.

Education

- All athletes should be properly educated on the correct sport technique.
- Coaches should have formal training in safe instructional practices.

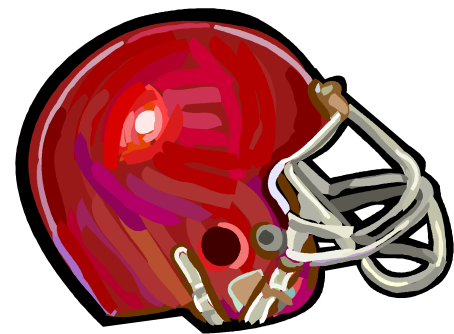
Safety

- Safety rules should be enforced.
- Develop plans and procedures for the safety and the security of athletes.



Protective Equipment

- Protective equipment must be certified, of good quality, well maintained and properly fitted.



Helmets

- Helmets are known to reduce the risk of intracranial injury however, there is no helmet that can prevent all head injuries.
- An athlete should wear the correctly sized helmet and one specific to the activity (hockey, football, snowboard, bike).

Helmets

- Single-impact helmets (“crash helmets”) are designed to protect your head against a single hard fall (ex. bike helmets).
- These helmets should be replaced after a hard fall.

Sportsmanship

- Participate with the ideas of Fair Play and Sportsmanship in mind.



Knowledge Transfer

- Education of athletes, parents, coaches
- Awareness of concussion symptoms and signs
- Fair play and respect

Future Directions

- Validation of the SCAT2
- On-field injury severity predictors
- Gender effects on injury risk, severity and outcome
- Pediatric injury and management paradigms
- Virtual reality tools in the assessment of injury
- Rehabilitation strategies (e.g. exercise therapy)
- Novel Imaging modalities and their role in clinical assessment
- Concussion surveillance using consistent definitions and outcome measures
- Clinical assessment where no baseline assessment has been performed
- 'Best-practice' neuropsychological testing
- Long term outcomes

Thank-You for Coming!

Dr. Martin Mrazik

Dr. Terry DeFreitas

Glen Sather Sports Medicine Clinic
University of Alberta

