Concussion: Evaluation/Management/ RTP Guidelines

Polar Bear Sports Medicine Conference

May 15, 2015

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OA Centers for Orthopaedics

BOC for the Athletic Trainer

- **At the conclusion of this presentation, the participant should be able to:**
  - Define Sports Related Concussion (SRC) and describe how it is diagnosed
  - Identify how to manage and treat SRC
  - Outline return to learn and return to play protocols
  - Describe strategies for the prevention of SRC


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Dogs


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GuildAcademy
Competition Program
PLUS
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Concussion

"Any alteration of mental function following a blow to the head that may or may not involve a loss of consciousness"

American Academy of Neurology, 1997

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Concussion

"Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces…"

Zurich Consensus Statement, 2012

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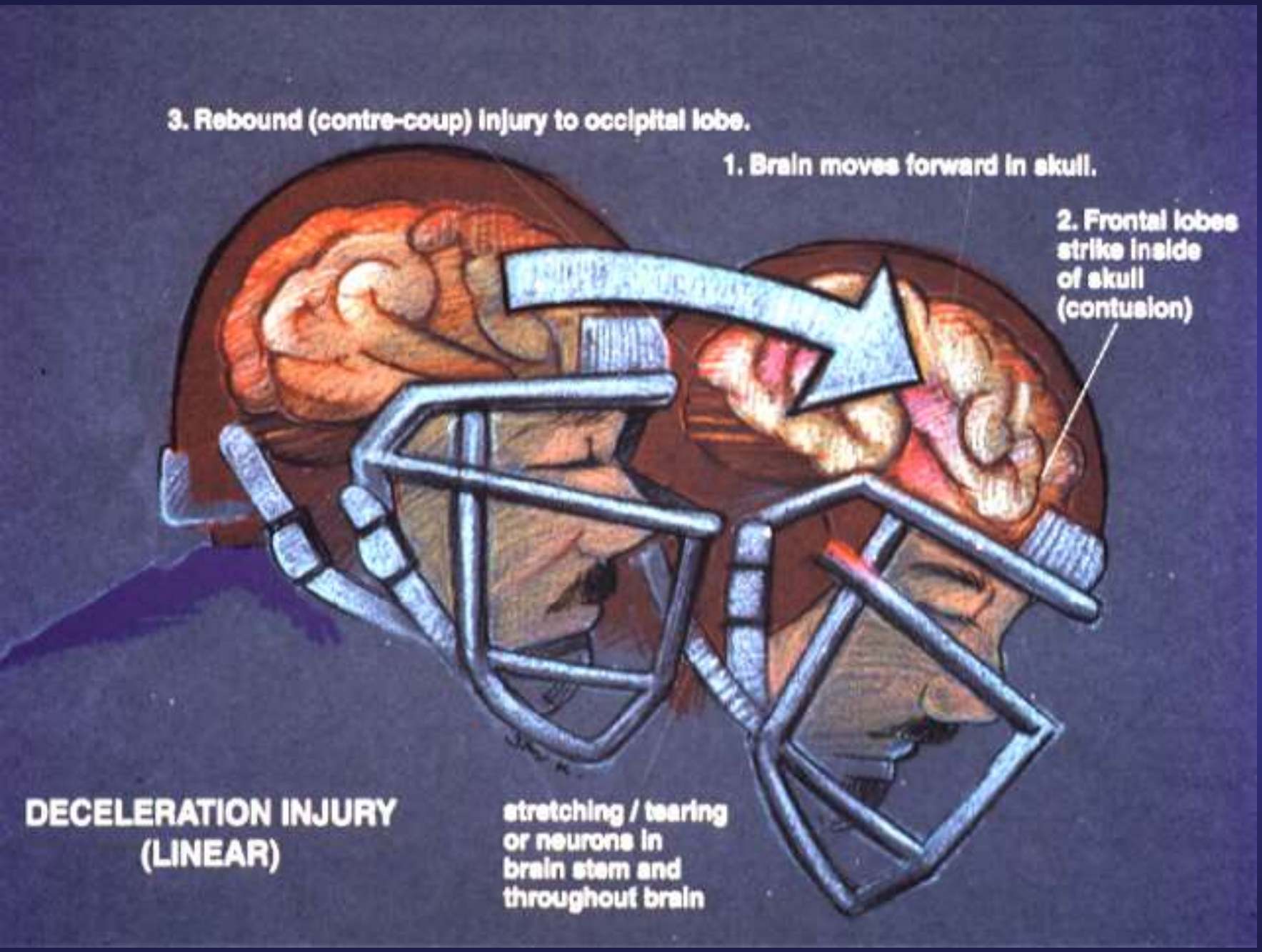
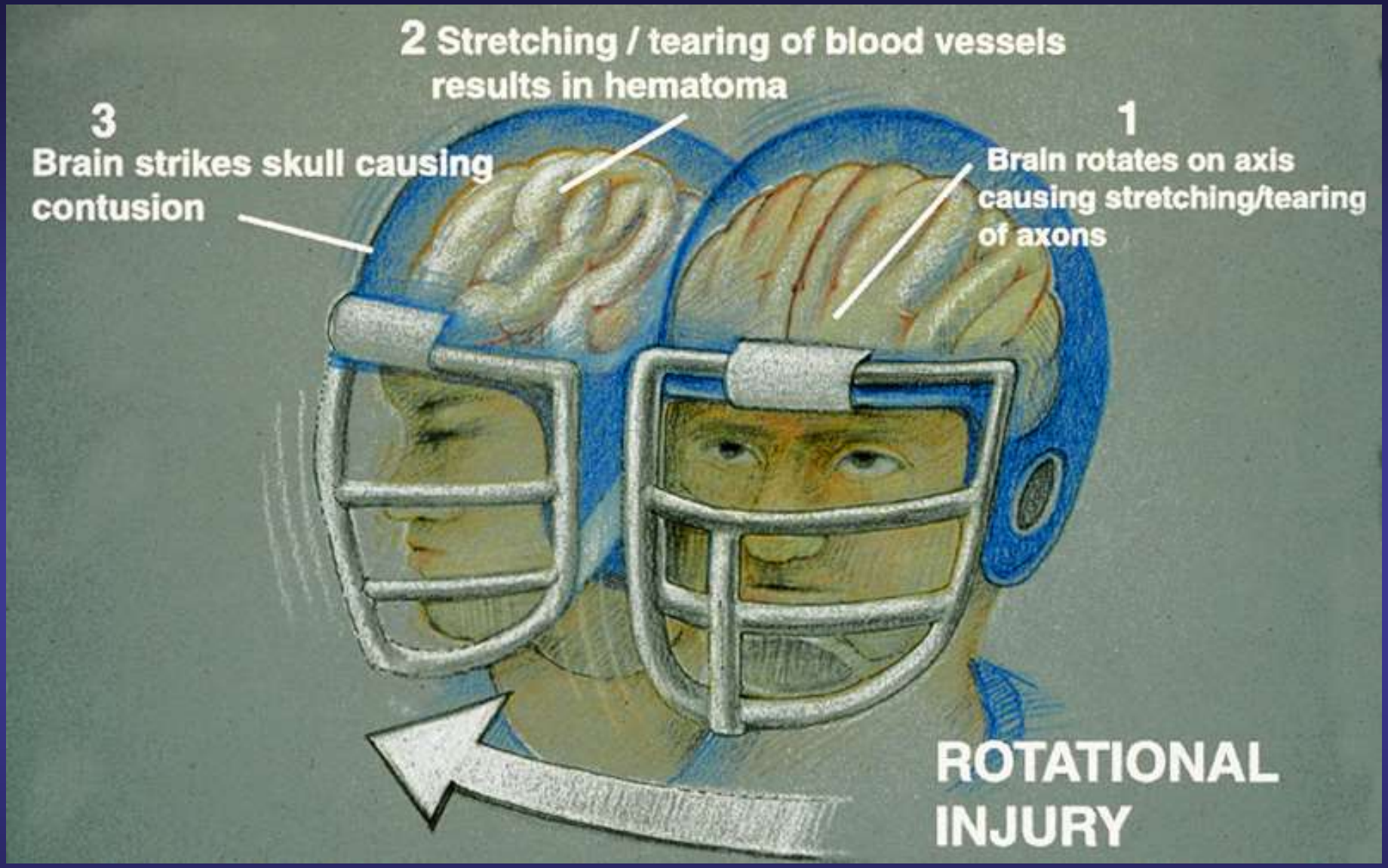
What is a Sports-Related Concussion?

- Subset of TBI, often referred to as a mTBI, more accurate to call it SRC
- Neurological impairment which has *rapid onset,* and is *self-resolving* and *short-lived* (usually)
- Functional rather than structural disturbance (normal head imaging studies)
- Caused by a direct hit or indirect "jarring" of the head

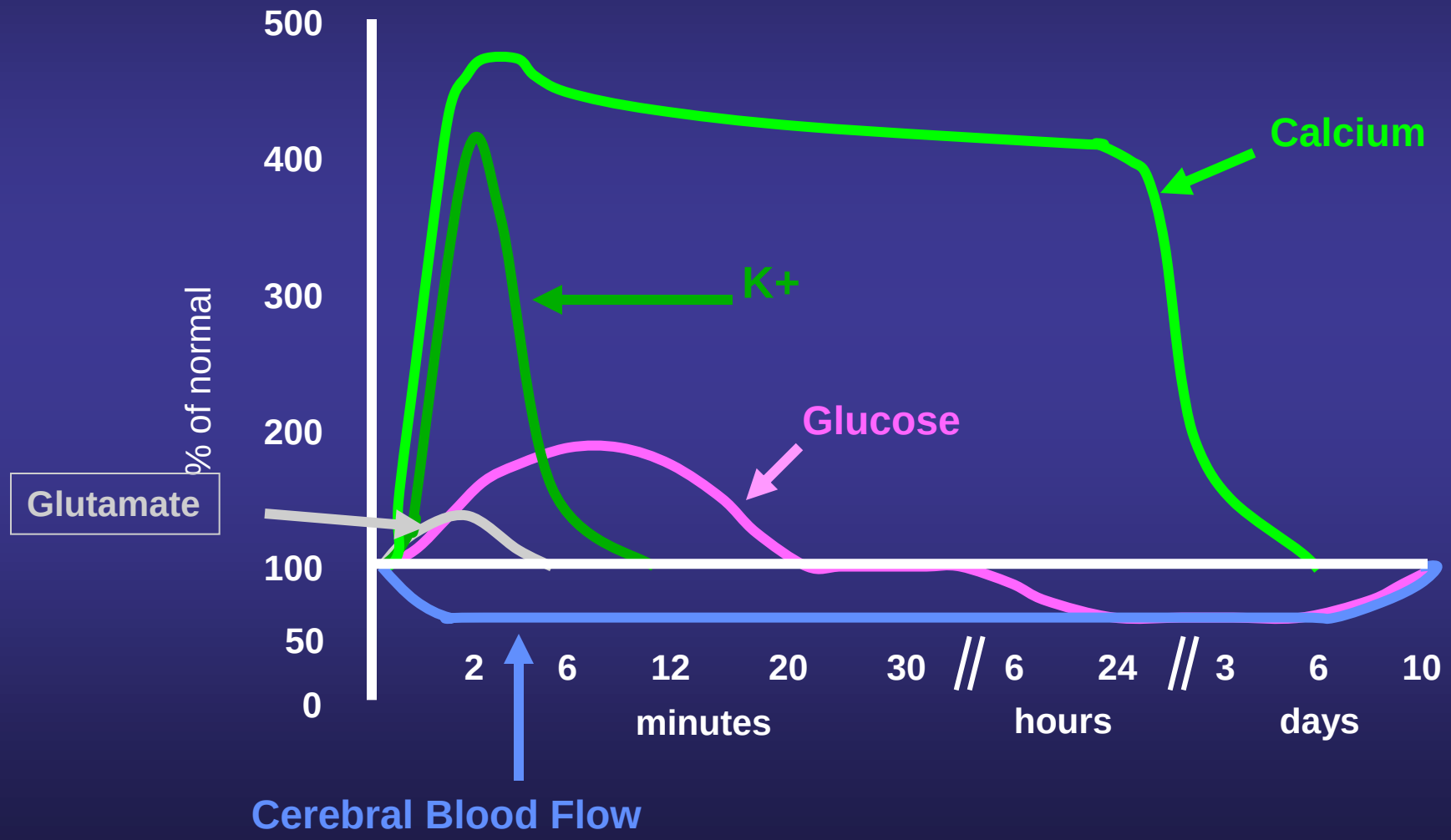

3. Rebound (contre-coup) injury to occipital lobe.
1. Brain moves forward in skull.
2. Frontal lobes strike inside of skull (contusion)
DECELERATION INJURY (LINEAR)
stretching / tearing or neurons in brain stem and throughout brain


2 Stretching / tearing of blood vessels results in hematoma
3
Brain strikes skull causing contusion
1
Brain rotates on axis causing stretching/tearing of axons
ROTATIONAL INJURY

Concussion Video

Neurometabolic Cascade Following Cerebral Concussion

(Giza & Hovda, 2001)



UCLA Brain Injury Research Center

What is a SRC: Microscopic Level

- Concussion physiology is not entirely understood - described as a complex cascade of biochemical, metabolic, and gene expression changes.
- No cell death –unlike ischemic stroke, but do have period of susceptibility after hit (concussive penumbra).
- Causes disruption of the energy delivery systems

What is a SRC: Macroscopic Level

- Different people react differently to similar injuries.
- The same person may react differently to the same injury at a different time.
- Helps to explain why impact sensors are of limited value.

Epidemiology
Who Gets Concussed?

- 248,418 annual ED visits for nonfatal TBI's related to sports and recreation activity in persons aged ≤19. (MMWR 2011)
- Up to 80% of concussions go undiagnosed and untreated.
- Concussions represent 8.9% of all high school athletic injuries and 5.8% of all collegiate athletic injuries. (Gessel, *et. al*., 2007)
- The rates of concussions are highest in football (8.67 per 10,000 AE), girls' soccer (5.83 per 10,000 AE), boys' ice hockey (6.83 per 10,000 AE) and boys' LAX (4.87 per 10,000 AE) (NFHS High School RIO Injury Surveillance 2008-2014).

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Football Injury Data
Concussions 2005/06-2013/14

After eight consecutive years of increasing concussion rates, Football concussion rates decreased from 2012/13 to 2013/14

- 4.66 per 10,000 AE 2005/06
- 9.08 per 10,000 AE 2011/12
- 10.77 per 10,000 AE 2012/13
- 10.45 per 10,000 AE 2013/14

- Boys' Ice Hockey – 9.52/10,000 AE 2013/14.
- Boys' wrestling – 5.81/10,000 AE 2013/14.
- Boys' Lacrosse – 4.79/10,000 AE 2013/14.
- Girls' soccer - 7.91/10,000 AE 2013/14.
- Boys' soccer – 3.39/10,000 AE 2013/14.
- Girls' basketball- 4.56/10,000 AE 2013/14.
- Boy' basketball – 2.11/10,000 AE 2013/14.

Does Gender Matter?

Gessel, *et. al.*, *Journal of Athletic Training*, 2007

- **The explanation for the observed sex differences in concussion is most likely multifactorial:**
  - **Biomechanical differences – smaller head to ball ratio, weaker necks, head and neck acceleration differences, differences in style of play.**
  - **Cultural differences – traditionally, US society tends to be more protective of female athletes.**

MTBI Signs & Symptom

Concussion Signs

- Appears dazed
- Confused about play
- Moves clumsily
- Answers question slowly
- Personality/behavior change
- Forgets plays prior to hit
  Retrograde amnesia
- Forgets plays after hit
  Anterograde amnesia
- LOC

Concussion Symptoms

- Headache
- Nausea
- Balance problems
- Double vision
- Feeling sluggish
- Feeling foggy
- Change in sleep pattern
- Cognitive changes

Commonly Reported Symptoms

High School & College Athletes - within 3 days of injury

# 1	**Headache**	71 %
# 2	**Feeling slowed down**	58 %
# 3	**Difficulty concentrating**	57 %
# 4	**Dizziness**	55 %
# 5	**Fogginess**	53 %
# 6	**Fatigue**	50 %
# 7	**Visual Blurring/double vision**	49 %
# 8	**Light sensitivity**	47 %
# 9	**Memory dysfunction**	43 %
# 10	**Balance problems**	43 %

Lovell, Collins et al., 2004; N = 215

Tools for Concussion Diagnosis

- Evaluation by a trained professional
- Neurocognitive computerized testing (ImPACT, CogSport)
- Many others including:
  - Sports Concussion Assessment Tool (SCAT3)
  - Standardized Assessment of Concussion (SAC)
  - King-Devick Sideline Concussion Test
  - NHL Physician Evaluation Form
  - McGill Abbreviated Concussion Evaluation (ACE)
  - Colorado Medical Society Guidelines
  - Maddocks Questions
  - AAN Sports Palm Card

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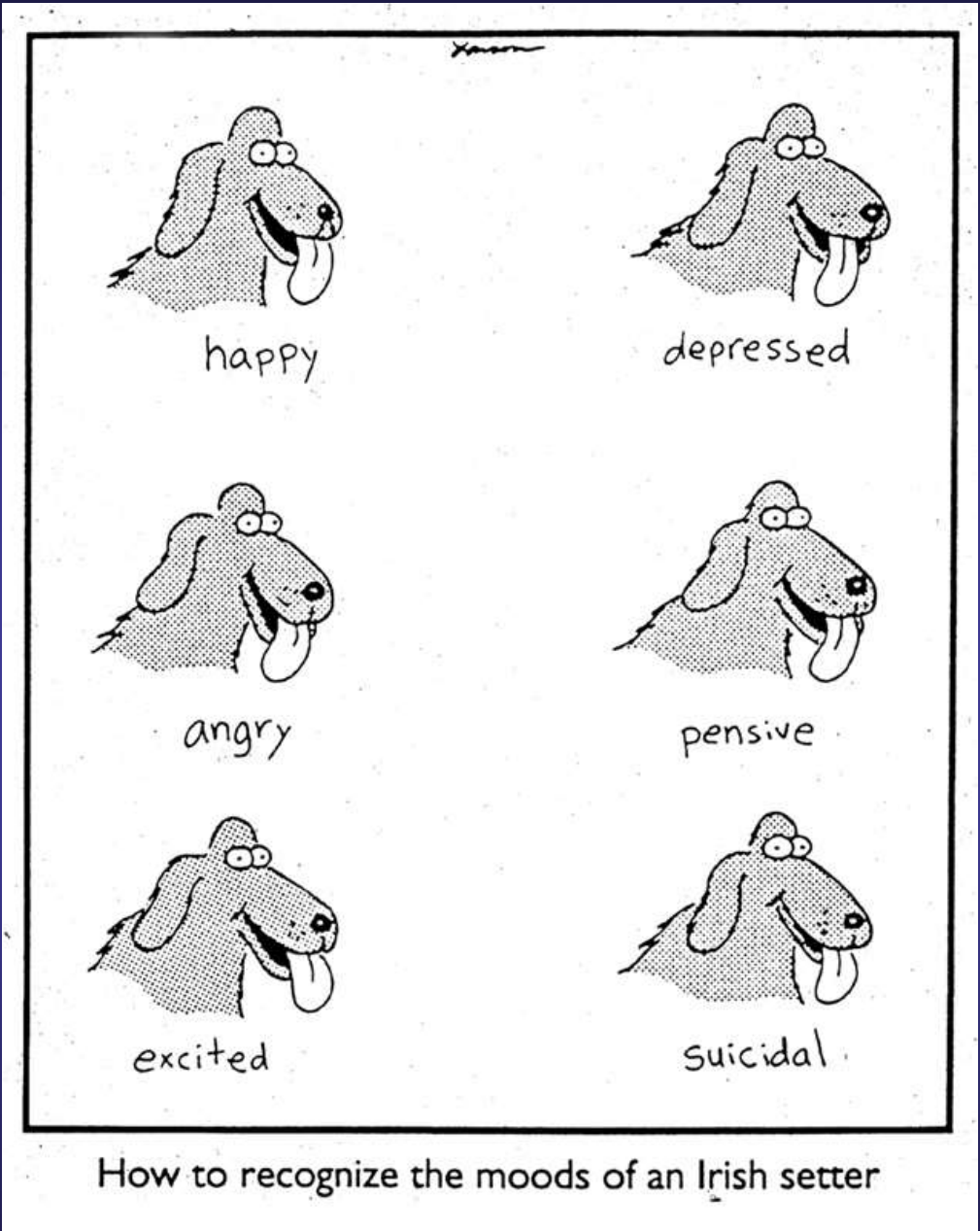
Concussion Management

Concussion

The Diagnostic and Return to School/Play Dilemma



Concussion management by primary care providers.

Pleacher MD, Dexter WW - *Br J Sports Med* - 2006; 40(1):

- 2004 – Eleven item questionnaire to all PCP's in ME. 50.8% (367/723) response rate.
- 70% of responders used published guidelines as a tool in concussion management.
- 16% of responders had access to NS tests within one week of the concussion.

Free CDC Tool Kit on Concussion for High School Coaches!

- If you think your athlete has sustained a concussion… don't assess it yourself.
  Take him/her out of play, and
  seek the advice of a health care professional.
- http://www.cdc.gov/ncipc/tbi/Coaches_Tool_Kit.htm

FREE CDC Tool Kit on Concussion for High School Coaches

DID YOU KNOW?

- Each year, as many as 3.8 million sports- and recreation-related concussions occur in this country.
- Athletes who have had at least one concussion are at increased risk for another concussion.
- A repeat concussion that happens before the brain fully recovers from the first can result in brainswelling, permanent brain damage, and even death. This is called "second impact syndrome."

The Centers for Disease Control and Prevention (CDC) has created a free tool kit, *Heads Up: Concussion in High School Sports*, that provides useful tools and information to help coaches, as well as athletic directors and trainers, prevent, recognize, and manage concussions.

The tool kit contains practical, easy-to-use information including:

- **A video and DVD;**
- **A coach's guide with information about preventing and managing concussion;**
- **A wallet card and clipboard sticker for coaches;**
- **Posters to hang in locker rooms;**
- **Fact sheets in English and Spanish for athletes and their parents; and**
- **A CD-ROM with downloadable kit materials and additional concussion-related resources.**

To order or download this tool kit free-of-charge, go to: http://www.cdc.gov/ncipc/tbi/Coaches_Tool_Kit.htm.

For more information or questions on the *Heads Up: Concussion in High School Sports* tool kit, please contact CDC at 1-800-CDC-INFO (232-4636) or email at cdcinfo@cdc.gov.

It's better to miss one game than the whole season.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION

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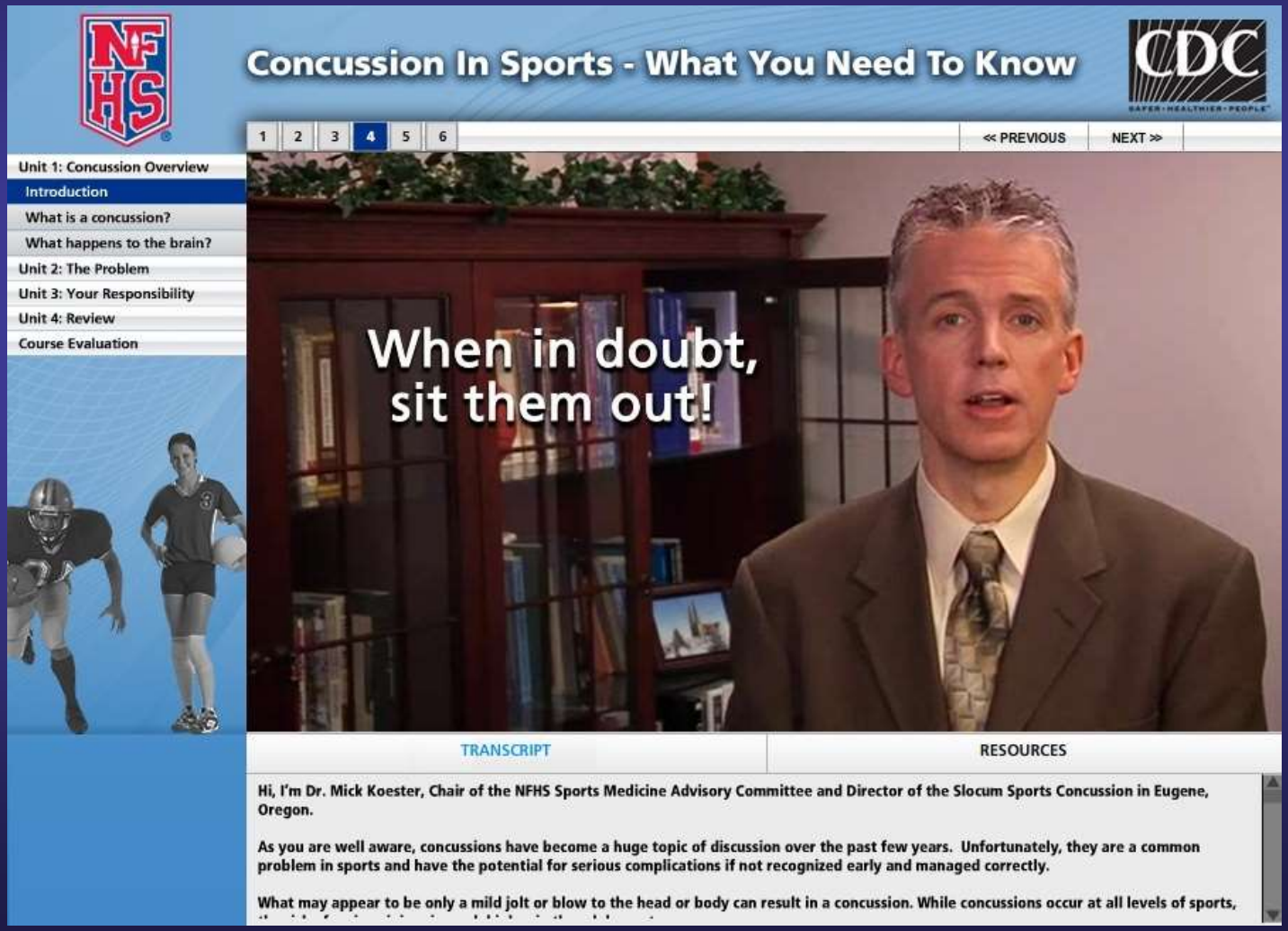
“Concussion in Sport - What You Need to Know”

www.nfhslearn.com



NFHS Suggested Guidelines for Management of Concussion

National Federation of State High School Associations

Suggested Guidelines for Management of Concussion

A concussion is a traumatic brain injury that interferes with normal brain function. An athlete does not have to lose consciousness (be "knocked out") to have suffered a concussion.

Common Symptoms of Concussion Include:

- headache
- fogginess
- difficulty concentrating
- easily confused
- slowed thought processes
- difficulty with memory
- nausea
- lack of energy, tiredness
- dizziness, poor balance
- blurred vision
- sensitive to light and sounds
- mood changes – irritable, anxious or tearful
- appears dazed or stunned
- confused about assignment
- forgets plays
- unsure of game, score or opponent
- moves clumsily
- answers questions slowly
- loses consciousness
- shows behavior or personality changes

Suggested Concussion Management:

1. No athlete should return to play (RTP) or practice on the same day of a concussion.
2. Any athlete suspected of having a concussion should be evaluated by an appropriate health-care professional that day.
3. Any athlete with a concussion should be medically cleared by an appropriate health-care professional prior to resuming participation in any practice or competition.
4. After medical clearance, RTP should follow a step-wise protocol with provisions for delayed RTP based upon return of any signs or symptoms.

For further details please see the "NFHS Suggested Guidelines for Management of Concussion" at www.nfhs.org.

January 2011

See Appendix B in all of the 2014-15 NFHS Rules Book

1ST-4th International Symposium on Concussion in Sport (Vienna, Prague, Zurich, Zurich): Clinical Points of Emphasis

1. *Abandonment of grading scale approach, recommend individualized management of injury.*

2. *When player exhibits any signs/symptoms of concussion, he/she should be removed from contest and **not allowed** to return to play in that same contest.*

3. *Following concussion, athlete should engage in stepwise exertional progression prior to RTP*

4. *Objective tools (e.g. neurocognitive/balance testing) should augment post-injury clinical evaluation.* ***No athlete should return to play if any symptoms, neurocognitive, or balance deficits persist at rest or with exertion.***

American Academy of Pediatrics

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Guidance for the Clinician in Rendering Pediatric Care

CLINICAL REPORT

Returning to Learning Following a Concussion

abstract

Following a concussion, it is common for children and adolescents to experience difficulties in the school setting. Cognitive difficulties, such as learning new tasks or remembering previously learned material, may pose challenges in the classroom. The school environment may also increase symptoms with exposure to bright lights and screens or noisy cafeterias and hallways. Unfortunately, because most children and adolescents look physically normal after a concussion, school officials often fail to recognize the need for academic or environmental adjustments. Appropriate guidance and recommendations from the pediatrician may ease the transition back to the school environment and facilitate the recovery of the child or adolescent. This report serves to provide a better understanding of possible factors that may contribute to diffi-

Mark E. Halstead, MD, FAAP, Karen McAvoy, PsyD, Cynthia D. Devore, MD, FAAP, Rebecca Carl, MD, FAAP, Michael Lee, MD, FAAP, Kelsey Logan, MD, FAAP, Council on Sports Medicine and Fitness, and Council on School Health

KEY WORDS

head injury, mild traumatic brain injury, pediatrics, return to school, academics, return to learn, cognitive deficits

ABBREVIATIONS

AT—certified athletic trainer
FERPA—Family Educational Rights and Privacy Act
HIPAA—Health Insurance Portability and Accountability Act
IEP—individualized education plan
IDEA—Individuals with Disabilities Education Act
RTL—return to learn

GUIDELINES FOR POST-CONCUSSION ACADEMIC ACCOMMODATIONS

Stage	Goals/Key Ideas	Expected Duration	Teacher's Actions	Student's Actions
I	Complete rest	2-6 days	• Contacted by school nurse • Explanation of injury and current plan of care	• Out of school • Strict limits for use of computer, cell phone, texting, video games • **No Physical/Sports Activity**
II	Significant deficits in processing and concentration. Cognitive activity as tolerated	2-14 days	Develop lists of three categories for all assignments: 1. Excused: Not to be made up. 2. Accountable: Responsible for content, not process. May be notes or work shared by a classmate, or may be covered in a review sheet. 3. Responsible: Must be completed by student and will be graded.	• In school as tolerated • When present, observing not participating. Get copies of notes, handouts, etc. • Communicate with teachers about progress/challenges. • Be patient with slow recovery, just do your best. • **No Physical/Sports Activity**
III	Gradual increase of time and energy, slowly resuming full workload	Variable duration. Hopefully 3-7 days, possibly more.	• Prioritize assignments with student, both make- up work and new work. • Continue to use lists with the three categories for assignments until all work is completed, and assist with setting a timeline for completion of assignments.	• Communicate with teachers on your progress with assignments. Communicate with teachers and parents on the pace of resuming a full workload and completing make-up work. • **No Physical/Sports Activity**
IV	Complete resumption of normal activities		• Monitor completion of assignments. • Communicate with parents and staff as to when student is caught up with assignments and working at the same pace as their classmates. • Communicate with Guidance Office as grades are updated	• Resume all normal activities. • Progress with athletic trainer – supervision resumption of participation in athletics.

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Rocky Mountain Hospital for Children
Center for Concussion

Suggested School Adjustments

720.979.0840
303.690.5948 Fax
YouthSportsMed.com

Student Name:_____ **Date :**_____ **Healthcare Signature:**_____

The student named above has recently suffered a concussion. A concussion is a brain injury. Concussion symptoms tend to slowly and steadily get better over 3 weeks but can take longer. Students should be provided these academic adjustments **WITHOUT PENALTY**. Please do not SAVE UP work for the student to complete later. Grade student on work completed, not on work missed during recovery. Please **CHECK IN** frequently with the student, ask student how they are doing, be alert for signs of fatigue and adjust academic demands accordingly.

You may lift cognitive restrictions as tolerated.

Remember Teachers: A student has limited "mental reserve" during recovery. Please analyze and categorize your workload:

- **Excused** – Work does NOT need to be made up
- **Accountable** – Student is responsible for content only but only defined products
- **Essential** – Work must be completed (then consider an adjusted due date)

Adapted from Bill Heinz, MD

	General		Cognitive/Thinking		Fatigue/Physical		Emotional
	No physical education classes including: weight training, aerobics, yoga, and dance until cleared by a healthcare professional.		**Reduce** in class/homework to critical tasks only. **Remove** non-essential in-class work and homework. **Grade work completed versus work needed.**		Allow student to wear sunglasses indoors to control for light sensitivity or noise cancelling headphones or earplugs for sound sensitivity.		Allow student to stay engaged in sport practices/activities when, and only when, they are attending classes fulltime with no symptoms.
	For younger children who still have recess, give the child an alternative activity (even rest) at recess. **No physical play at recess!**		Provide extended time to complete assignments/tests and/or shorten assignments as needed. **Adjust "due dates"**		Allow time to visit school nurse/counselor for treatment of headaches or other symptoms.		Develop an emotional support plan for the student including an adult with whom he/she can talk if feeling overwhelmed.
	In the majority of concussions, student's symptoms only keep them out of school for **2-3 days.** If a concussed student is absent for more than 3 days, **immediately** call a meeting with parents and seek a medical explanation.		**Limit** or **remove tests** (e.g., midterms, finals, standardized) or "high stakes projects" during the acute phase of recovery. As testing/projects are added back in, allow for alternative tests (oral or portfolio).		Allow "strategic rest breaks" during the day – 15 to 20 minute rest breaks that are **built** into the day, not just as needed.		Teach teacher and student to recognize fatigue and develop signal/plan so student can discreetly remove self from class OR rest in class for a designated "brain rest".

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Vestibular Pathoanatomy and Concussions

- **Dizziness is a frequent symptom of the concussed patient**
  - Reported in 23%-81% of cases in the first days after injury (Vestib rehab for dizziness and balance disorders after concussion)
- Poor balance and postural instability widely reported as well (Vestib rehab for dizziness and balance disorders after concussion, 9-11)
  - Correlated with dysfunction in sensory integration (Vestib rehab for dizziness and balance disorders after concussion, 12,13)

Vestibulo-Ocular Reflex (VOR)

- Reflex eye movement triggered by the vestibular system
- Stabilizes visual images during head movement by producing eye movement in the opposite direction of head movement
- Following concussion VOR can be compromised, resulting in altered VOR function.

Vestibular and Balance Exam

- **Subjective Questionnaire**
  - Dizziness Handicap Inventory (DHI)
- **Neurological examination**
  - Cranial Nerve Testing I-VII, if indicated
  - VOR head thrust
  - Saccades
  - Pursuits
  - Romberg
  - Dix-Hallpike, if indicated
- **Balance examination**
  - Balance Error Scouring System (BESS)

Neurometabolic Testing: Balke Protocol

- **Patients will perform an incremental treadmill exercise test according to a standard Balke protocol to the first sign of symptom exacerbation.**
- **Parameters:**
  - First minute: the treadmill speed will be set at 3.3 mph at 0.0% incline.
  - Second minute, the grade will be increased to 2.0% while maintaining the same speed.
  - Third minute and each minute thereafter, the grade is increased by 1.0%, maintaining speed at 3.3 mph.

Neurometabolic Testing: Balke Protocol

- Ratings of perceived exertion will be measured every minute in addition to assessment heart rate and symptoms.
- The test will be terminated at report of exacerbation of post concussive symptoms.
- After test termination, subjects will monitored up to 60 minutes, until patient feels symptoms have dissipated and are comfortable to leave.
- Establish the threshold heart rate when symptom exacerbation occurs.
- Corresponding visits exercise will be prescribed at 80% of threshold.

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Vestibular and Balance Treatment

- VOR Habituation
- Balance retraining
- Dix-Hallpike and Epley's Maneuver

Neurometabolic Treatment Progression

- Treatment will be prescribed at 80% of HR threshold.
- Exercise recommendation:
  - 20 minutes of aerobic exercise (1-2x/day)
  - Bike, TM, Swimming, Rower
    - **Easy, non impact is typically responded to well**
  - Consider sport specific activities or circuits
    - **Cautious, don't be reckless.**
- Teach how to monitor their own HR for HEP

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Progressive Activity Program

Step 1: Light exercise

-5 to 10 minutes on an exercise bike or light jog

-No weight lifting

Step 2: Running in the gym or on the field without a helmet or other equipment.

Step 3: Non-contact training drills in full uniform.

-Begin light weight training

Step 4: Full-contact practice or training

Step 5: Get back into the game!

Concussion Risk Reduction

NFHS Concussion Summit Task Force – July 2014

- 24-member task force including physicians, ATC's, HS football coaches, AD's, State Association directors, NCAA, NFL, USA Football.
- Developed nine fundamental recommendations and guidelines for minimizing the risk of concussions and head impact exposure in HS football.
- Approved by the NFHS SMAC and NFHS Board of Directors.
- Scheduled for implementation in the 2015 football season.

NFHS Concussion Summit Task Force – July 2014

- The goal is to reasonably limit overall exposure to multiple blows to head and body (*head impact exposure*) and minimize concussion risk, while maintaining the integrity of the game and avoiding unintended consequences.
- Primary concern is that of long-term adverse cognitive, emotional, and/or neurologic effects from concussions and repetitive blows to the head that may or may not result in the clinical symptoms of concussion.

NFHS Concussion Summit Task Force – July 2014

1. Defined full-contact as both “Thud” and “Live Action” using the USA Football definitions of *Levels of Contact*.
2. Full-contact allowed in no more than 2-3 practices per week, no more than 60-90 minutes per week, no more than 30 minutes per day, and limiting full-contact on consecutive days.
3. Pre-season practices may require more full-contact time than regular season practices in order to teach fundamentals.

NFHS Concussion Summit Task Force – July 2014

4. During pre-season twice-daily practices, only one session per day should include full-contact.

5. State Associations should review its policies regarding total quarters or games played during a 1-week time frame.

6. State Associations should review its policies regarding football outside of the traditional fall football season.

NFHS Concussion Summit Task Force – July 2014

7. State Associations should reach out to its state coaches' association to design and implement a coach education program to integrate youth, middle school and high school football programs.

8. State Associations should regularly educate its schools on current state concussion law and policies and encourage schools to have a written Concussion Management Protocol.

9. Every high school needs an Emergency Action Plan. When possible, an ATC should be present at all practices and games.

ANYONE CAN SAVE A LIFE

Emergency Response Planning Guide

for after-school practices and events

Plan. Learn. **Save.**

Developed and supported by

Minnesota State High School League

Medtronic FOUNDATION

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Protective Equipment

Mouth guard use demonstrated no effect in reducing neurocognitive deficits or symptoms of sports concussion

(Mihalik, Pardini, Guskiewicz, Collins, Lovell et al. Dental Traumatology, 2006)


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Prevention

- **Mouth guards**
  - No proven benefit in reducing concussion risk – very effective at preventing peri-oral and dental injury
- **Helmets**
  - Designed to prevent skull fractures – not concussions.
  - PROPER FIT most important aspect
  - Virginia Tech STAR study helmet ranking
    - **Should not be considered accurate – too many limitations**

Detection

- **Helmets**
  - Impact sensors (Shockbox, Shok-SpotR, Heads-up Stabilizer™)

Detection


PROTECT
THE PLAYERS.
PATENT-PENDING SENSOR SYSTEMS
LEARN MORE
Brain Sentry
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Detection

- Impact monitoring system on chin strap
  - Light flashes above ~70g impact
- Not a proven technology
- Not 100% accurate
- Flashing lights are NOT a sign or symptom of concussion and **will not diagnose a concussion**.


Skagen


FULL
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Framing the Issues: What We Know

- **Clinical symptoms/cognitive deficits appear linked to brain-related changes in physiology**
- **Changes in physiology lead to period of vulnerability**
- **During period of vulnerability, less biomechanical force results in more serious injury**
- **During period of vulnerability, physical and cognitive exertion protracts and complicates recovery**

Framing the Issues: What We Know

- **Certain risk factors likely heighten risk of sustaining concussion <u>and</u> exhibiting complicated recovery**
- **As we learn more, management becomes more conservative**
- **Comprehensive evaluation with objective tools are critical to determine clinical/academic management and safe return to function/play**

What We Still Don't Know…

- **Appropriate thresholds to define injury - When is the brain truly concussed?**
- **How long is period of physiologic vulnerability?**
- **Does the brain truly recover?**
- **What are the exact risk factors for complicated outcomes?**
- **Does proper management of injury mitigate <u>all</u> risk of recurrent injury?**

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What We Still Don't Know…

- **What is true morbidity of concussive injury in terms of academic effects, chronic symptoms, neurobehavioral presentation?**
- **What are potential long-term effects of concussive injury, if any?**
- **<u>What do we do in the interim, until questions are resolved?</u>**

Thank you!