Jacked-Up!

A Discussion on Youth Concussions

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Sports Medicine Physician
Overview

- What is a Concussion?
- Signs/ Symptoms
  - Red Flags
- Sideline/ School Evaluation
- Physician Evaluation
- Follow-up/ Treatment
- Academic Accommodations
- Return to Play
  - Second Impact Syndrome
  - Post- Concussive Syndrome
- Concussion Prevention
- Take Home Points
What a Concussion is NOT

• It is NOT a Structural Injury
  – Brain Bleed
  – Brain Swelling
  – “Bruised” Brain

• Does NOT require a loss of consciousness

• A concussion IS a functional/metabolic brain injury
What is a Concussion?

Zurich 4th International Conference on Concussion in Sport (2012):

- A Concussion is a brain injury and a complex pathophysiological process induced by biomechanical forces.
  - **Direct blow** to head, face, neck
  - **Indirect blow** to the body with “impulsive” force transmission
- Rapid onset of short-lived neurological impairment
  - Often resolves spontaneously
  - Symptoms/ signs may evolve over minutes to hours
- Reflects a functional rather than a structural injury
  - no abnormality seen on standard neuroimaging
  - “Energy crisis” (decreased available energy)
  - Neuropathologic (structural) changes can occur; rare
- May or may not involve loss of consciousness
  - Resolution of clinical/ cognitive symptoms typically sequential; In some cases symptoms may be prolonged
  - Repetitive injury (particularly during the recovery period) results in more severe/ often life-threatening conditions
Concussion Demographics

• 2015 study published within American Journal of Sports Medicine regarding the frequency and distribution of Sports Related Concussions in NCAA athletes
  – 10,560 reported concussions annually
  – More concussions occurred during competition (53.2%)
  – More concussions occurred from player contact (68%)
  – Largest rates within Men’s Wrestling, Men’s Ice Hockey, Women’s Ice Hockey, and Men’s Football
  – Largest annual numbers in Men’s Football, Women’s Soccer, Women’s Basketball

• 2012 study published within American Journal of Sports Medicine indicate that concussions within high school athletes comprise 15-25% of total injuries reported (cheerleading with over 20% total injuries and higher during practice!)

• 2014 study published within Journal of Athletic Training for Middle School Athletes:
  – Rates higher in games vs. practice
  – Boys with 3x greater rate of injury primarily (due to football)
  – Girls concussions primarily within soccer and basketball
Concussion Demographics

- High school sports: 135,000–300,000 concussions/yr
- **Higher risk in younger athletes/students**
  - High school football players (11.2) with nearly two fold increase risk of concussion compared with college counterparts (6.3): *per 10,000 athletic exposures
- **Females have an increased rate of concussions, increased severity, and length of symptoms**
- Reported High School Concussion Rates (per 10,000 athletic exposures):
  - Football: **11.2 (male)**
  - Lacrosse: **6.9 (male)/ 5.2 (female)**
  - Soccer: 4.2 (male)/ **6.7 (female)**
  - Wrestling: **6.2 (male)**
  - Basketball: 2.8 (male)/ **5.6 (female)**
  - Field Hockey: 4.2 (female)
  - Softball: 1.6 (female)
  - Baseball: 1.2 (male)

* Source: National Academy of Sciences (2010-2012)
Differences Among Youth

- Youth athletes take longer to recover and experience greater severity of concussion symptoms
  - Greater dysfunction on neuropsychological/balance assessment tests
  - *Frontal lobes of brain continue to mature until approximately age 25*
- Young children (5-14) have the highest rates of concussion
  - Sports/ bicycle/ falls/ playground accidents
  - *Often undiagnosed*
- Children (defined as under 13) often report different symptoms than adults and require a separate evaluation
  - Symptoms can be vague and often subtle
Common Signs/ Symptoms

**Physical**
- Headache (migraine-like)
  - Sensitivity to light (photophobia) or noise (phonophobia)
  - Nausea (with/ without vomiting)
  - Worsened with cognitive or physical activity
- Dizziness/ disruption of balance
  - Motor clumsiness (stumbling, slowed movement)
- Visual blurriness, fuzziness or difficulty tracking

**Cognitive**
- Confusion/ disorientation
- Short term memory difficulties
  - *Retrograde amnesia* (loss of memory for events preceding injury)
  - *Anterograde amnesia* (difficulty with formation of new memory)
- Concentration problems
- Attention deficits
- Feeling mentally slowed down/ mentally “foggy”

**Sleep**
- Trouble falling asleep
- Sleeping more than usual
- Sleeping less than usual
- Frequently waking up
- Fatigue/ Drowsiness

**Emotional**
- Irritability
- Sadness
- Nervousness/ anxiety
- Mood swings (anger, crying, emotional lability, etc.)

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**CAUTION:**

*Concussion may occur without a headache*

*Symptoms may evolve and continue to develop up to 48 hours after initial injury*
Observed Signs/ Symptoms

- Lying motionless on the ground/ slow to get up
- Appears dazed or stunned; blank stare
- Grabbing/ clutching of the head
- Moves clumsily or in wrong direction; incoordination
- Confused about assignments or basic information
- Problems following commands (attention/ concentration)
- Unsure of games/ scores/ opponent/ surroundings
- Answers questions slowly
- **Loss of consciousness (even temporarily)**
  - *by definition this always is a concussion*
- Behavior or personality changes
- Forgets events prior to or after injury

*symptoms often not noticed until student resumes everyday life* (failure to recognize/ admit a problem) where they manifest with higher level functional processes

*sideline presentation may vary widely* from athlete to athlete depending on area of the brain affected and biomechanical forces involved
Sideline/ School Evaluation

• If a player shows **ANY** features of a concussion
  – Onsite evaluation by licensed healthcare provider
    • Exclude cervical spine injury and address first aid issues
    • Assess concussive injury using a standardized assessment tool if available (**SCAT3**, SAC, etc.)
      – Evaluation of cognitive function (attention, memory, etc.) is essential component of clinical assessment.
      – **Symptoms/ may be delayed several hours following a concussion (should be seen as an evolving injury)**
      – The individual should not be left alone following injury
      – Serial monitoring essential over initial few hours
      – **NO driving**
  – Student with suspected concussion **should not return to activity on same day of injury** until properly assessed
  – **Be conservative**; treat **ANY** sign/ symptom + direct/ indirect hit as a concussion
SCAT3 and Child-SCAT3

• Sideline evaluation of cognitive functioning in an essential component in the assessment of concussions
• SCAT3 is a standardized and universally accepted tool for evaluating injured athletes 13 and older
  – Sensitive and comprehensive initial sideline evaluation and designed for use by medical professionals only
    • Assesses both cognitive and physical functioning in 8 domains
    • Scoring should not be used as a stand alone method to diagnose a concussion, measure recovery, or make decisions about an athlete's return to play following a concussion
    • Consider re-evaluation as symptoms may evolve over time
    • Athlete may have a concussion even if their SCAT3 is normal
    • Baseline testing helpful as a comparison
  – Approximately 15-20 minutes to complete
  – Performed by a licensed healthcare professional (Physician, ATC, Physician Assistant, etc.)
  – Diagnosis of a concussion remains a clinical judgement
• For athletes < 13 years old (5-12), the Child-SCAT3 is preferred as the questions/ tests are age appropriate
If GCS < 14-15 seek immediate medical attention as symptoms suggestive of traumatic brain injury

<table>
<thead>
<tr>
<th>Glasgow coma scale (GCS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Best eye response (E)</strong></td>
</tr>
<tr>
<td>No eye opening</td>
</tr>
<tr>
<td>Eye opening in response to pain</td>
</tr>
<tr>
<td>Eye opening to speech</td>
</tr>
<tr>
<td>Eyes opening spontaneously</td>
</tr>
<tr>
<td><strong>Best verbal response (V)</strong></td>
</tr>
<tr>
<td>No verbal response</td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
</tr>
<tr>
<td>Inappropriate words</td>
</tr>
<tr>
<td>Confused</td>
</tr>
<tr>
<td>Oriented</td>
</tr>
<tr>
<td><strong>Best motor response (M)</strong></td>
</tr>
<tr>
<td>No motor response</td>
</tr>
<tr>
<td>Extension to pain</td>
</tr>
<tr>
<td>Abnormal flexion to pain</td>
</tr>
<tr>
<td>Flexion/Withdrawal to pain</td>
</tr>
<tr>
<td>Localizes to pain</td>
</tr>
<tr>
<td>Obey commands</td>
</tr>
<tr>
<td><strong>Glasgow Coma score (E + V + M)</strong></td>
</tr>
</tbody>
</table>

GCS should be recorded for all athletes in case of subsequent deterioration.
Maddocks score has high independent validity when evaluating a concussion.

- Sensitivity significantly increased when combined with symptom checklist and modified-BESS testing.

- More specific than just asking “who are you”/“where are we”
### Cognitive assessment

**Standardized Assessment of Concussion (SAC)**

- **Orientation** (1 point for each correct answer)
  - 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**

<table>
<thead>
<tr>
<th>Immediate memory</th>
<th>List</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Alternative word list</th>
</tr>
</thead>
<tbody>
<tr>
<td>elbow</td>
<td>0 1 0 1 0 1</td>
<td>candle</td>
<td>baby</td>
<td>finger</td>
<td></td>
</tr>
<tr>
<td>apple</td>
<td>0 1 0 1 0 1</td>
<td>paper</td>
<td>monkey</td>
<td>penny</td>
<td></td>
</tr>
<tr>
<td>carpet</td>
<td>0 1 0 1 0 1</td>
<td>sugar</td>
<td>perfume</td>
<td>blanket</td>
<td></td>
</tr>
<tr>
<td>saddle</td>
<td>0 1 0 1 0 1</td>
<td>sandwich</td>
<td>sunset</td>
<td>lemon</td>
<td></td>
</tr>
<tr>
<td>bubble</td>
<td>0 1 0 1 0 1</td>
<td>wagon</td>
<td>iron</td>
<td>insect</td>
<td></td>
</tr>
</tbody>
</table>

**Immediate memory score total**

<table>
<thead>
<tr>
<th>Concentration: Digits Backward</th>
<th>List</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Alternative digit list</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-9-3</td>
<td>0 1</td>
<td>6-2-9</td>
<td>5-2-6</td>
<td>4-1-5</td>
</tr>
<tr>
<td>3-8-1-4</td>
<td>0 1</td>
<td>3-2-7-9</td>
<td>1-7-9-5</td>
<td>4-9-6-8</td>
</tr>
<tr>
<td>6-2-9-7-1</td>
<td>0 1</td>
<td>1-5-2-8-6</td>
<td>3-8-5-2-7</td>
<td>6-1-8-4-3</td>
</tr>
<tr>
<td>7-1-8-4-6-2</td>
<td>0 1</td>
<td>5-3-9-1-4-8</td>
<td>8-3-1-9-6-4</td>
<td>7-2-4-8-5-6</td>
</tr>
</tbody>
</table>

**Concentration score**

**Concentration: Month in Reverse Order** (1 pt. for entire sequence correct)

Dec-Nov-Oct-Sept-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan 0 1

### Standardized Assessment of Concussion (SAC)

- Provides immediate sideline mental status assessment
- Addresses 4 primary areas of cognitive functioning:
  - Orientation
  - Immediate Memory (word recall)
  - Concentration (digits backward, months in reverse order)
  - Delayed recall (word recall repeated)
- Good sensitivity and specificity
- Total score out of 30 (average in non-concussed individuals is a 27)

### SAC Delayed Recall

**Delayed recall score**

- **SAC Delayed Recall**
- **Delayed recall score**
Modified Balance Error Scoring System (BESS)

- Hands on hips/ eyes closed, maintain position for 20 sec
- Assess Double leg/ Single leg/ Tandem stance
- Document the number of errors
- Types of Errors
  - Hands lifted off of hips
  - Opening eyes
  - Step, stumble, fall
  - Moving hips into > 30 degrees abduction
  - Lifting forefoot or heel
  - Remaining out of position > 5 s
- Maximum number of errors = 10
- Repeat 3 stances on medium density foam surface

Coordination Examination

- Finger to nose task (FTN)
  - 5 FTN repetitions using the index finger in < 4 seconds
• **Child-SCAT3**
  
  – For children 5-12 yo
  
  – Formats questions and tasks appropriate for age group
    
    • Maddocks substitutes (lunch, class, teacher)
    
    • Symptom evaluation includes a parent (or teacher) report
    
    • Modified BESS eliminates single leg stance and introduces a tandem gait
  
  – Look as well for subtle non-verbal signs (i.e. unable to comfort to complete test)
# SYMPTOM EVALUATION

## Child report

<table>
<thead>
<tr>
<th>Symptom</th>
<th>never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have trouble paying attention</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get distracted easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have a hard time concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems remembering what people tell me</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems following directions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I daydream too much</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get confused</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I forget things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have problems finishing things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have trouble figuring things out</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>It’s hard for me to learn new things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have headaches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel dizzy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel like the room is spinning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel like I’m going to faint</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Things are blurry when I look at them</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I see double</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I feel sick to my stomach</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get tired a lot</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I get tired easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

### Total number of symptoms (Maximum possible 20)

### Symptom severity score (Maximum possible 20 x 3 = 60)

- **self rated**
- **clinician interview**
- **self rated and clinician monitored**

## Parent report

<table>
<thead>
<tr>
<th>Symptom</th>
<th>never</th>
<th>rarely</th>
<th>sometimes</th>
<th>often</th>
</tr>
</thead>
<tbody>
<tr>
<td>The child</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has trouble sustaining attention</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>is easily distracted</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has problems remembering what he/she is told</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty following directions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>tends to daydream</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets confused</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>is forgetful</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has difficulty completing tasks</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has poor problem solving skills</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has problems learning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has headaches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feels dizzy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has a feeling that the room is spinning</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feels faint</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has blurred vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>has double vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>experiences nausea</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets tired a lot</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>gets tired easily</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

### Total number of symptoms (Maximum possible 20)

### Symptom severity score (Maximum possible 20 x 3 = 60)

- **parent self rated**
- **clinician interview**
- **parent self rated and clinician monitored**

### Overall rating

- **no different**
- **very different**
- **unsure**
- **N/A**

Name of person completing Parent-report:

Relationship to child of person completing Parent-report:
# COGNITIVE & PHYSICAL EVALUATION

## Cognitive assessment

**Standardized Assessment of Concussion – Child Version (SAC-C)**

<table>
<thead>
<tr>
<th>Orientation (1 point for each correct answer)</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>What month is it?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>What is the date today?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>What is the day of the week?</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>What year is it?</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Orientation score** of 4

<table>
<thead>
<tr>
<th>Immediate memory</th>
<th>List</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Alternative word list</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>elbow</td>
<td>0 1 0 1 0 1</td>
<td></td>
<td></td>
<td></td>
<td>candle baby finger</td>
</tr>
<tr>
<td>apple</td>
<td>0 1 0 1 0 1</td>
<td></td>
<td></td>
<td></td>
<td>paper monkey penny</td>
</tr>
<tr>
<td>carpet</td>
<td>0 1 0 1 0 1</td>
<td></td>
<td></td>
<td></td>
<td>sugar perfume blanket</td>
</tr>
<tr>
<td>saddle</td>
<td>0 1 0 1 0 1</td>
<td></td>
<td></td>
<td></td>
<td>sandwich sunset lemon</td>
</tr>
<tr>
<td>bubble</td>
<td>0 1 0 1 0 1</td>
<td></td>
<td></td>
<td></td>
<td>wagon iron insect</td>
</tr>
</tbody>
</table>

**Total Immediate memory score total** of 15

<table>
<thead>
<tr>
<th>Concentration:</th>
<th>Digits Backward</th>
<th>Alternative digit list</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>List</td>
<td>Trial 1</td>
</tr>
<tr>
<td></td>
<td>6-2</td>
<td>0 1 1 5-2</td>
</tr>
<tr>
<td></td>
<td>4-9-3</td>
<td>0 1 1 6-2-9</td>
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<tr>
<td></td>
<td>3-8-1-4</td>
<td>0 1 1 3-2-7-9</td>
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<td></td>
<td>6-2-9-7-1</td>
<td>0 1 1 1-5-2-8-6</td>
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<tr>
<td></td>
<td>7-1-8-4-6-2</td>
<td>0 1 1 5-3-9-1-4-8</td>
</tr>
</tbody>
</table>

**Total of 5**

<table>
<thead>
<tr>
<th>Concentration:</th>
<th>Days in Reverse Order (1 pt. for entire sequence correct)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sunday-Saturday-Friday-Thursday-Wednesday-Tuesday-Monday</td>
</tr>
<tr>
<td></td>
<td>0 1</td>
</tr>
</tbody>
</table>

**Concentration score** of 6

## Balance examination

Do one or both of the following tests.

**Footwear (shoes, barefoot, braces, tape, etc.)**

- **Modified Balance Error Scoring System (BESS) testing**
  - Which foot was tested (i.e. which is the non-dominant foot): [Left] [Right]
  - Testing surface (hard floor, field, etc.): [ ]

**Condition**

- Double leg stance: [ ] [Errors]
- Tandem stance (non-dominant foot at back): [ ] [Errors]

**Tandem gait**

- Time taken to complete one trial: [ ] seconds
- If child attempted, but unable to complete tandem gait, mark here [ ]

## Coordination examination

**Upper limb coordination**

- Which arm was tested: [Left] [Right]

**Coordination score** of 1

## SAC Delayed Recall

**Delayed recall score** of 5
Sport Concussion Recognition Tool

- Used by non-medical professionals for initial concussion recognition

Pocket CONCUSSION RECOGNITION TOOL™
To help identify concussion in children, youth and adults

RECOGNIZE & REMOVE
Concussion should be suspected if one or more of the following visible clues, signs, symptoms or errors in memory questions are present.

1. Visible clues of suspected concussion
Any one or more of the following visual clues can indicate a possible concussion:

- Loss of consciousness or responsiveness
- Lying motionless on ground/Slow to get up
- Unsteady on feet / Balance problems or falling over / Incoordination
- Grasping/Clutching of head
- Dazed, blank or vacant look
- Confused/Not aware of plays or events

2. Signs and symptoms of suspected concussion
Presence of any one or more of the following signs & symptoms may suggest a concussion:

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

3. Memory function
Failure to answer any of these questions correctly may suggest a concussion.

- “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?”

Any athlete with a suspected concussion should be IMMEDIATELY REMOVED FROM PLAY, and should not be returned to activity until they are assessed medically. Athletes with a suspected concussion should not be left alone and should not drive a motor vehicle.

It is recommended that, in all cases of suspected concussion, the player is referred to a medical professional for diagnosis and guidance as well as return to play decisions, even if the symptoms resolve.

RED FLAGS
If ANY of the following are reported then the player should be safely and immediately removed from the field. If no qualified medical professional is available, consider transporting by ambulance for urgent medical assessment:

- Athlete complains of neck pain
- Increasing confusion or irritability
- Repeated vomiting
- Seizure or convulsion
- Weakness or tingling/burning in arms or legs
- Deteriorating conscious state
- Severe or increasing headache
- Unusual behaviour change
- Double vision

Remember:
- In all cases, the basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Do not attempt to move the player (other than required for airway support) unless trained to so do.
- Do not remove helmet (if present) unless trained to do so.

Red Flags

- Signs/ Symptoms requiring immediate referral
  - Penetrating skull injury
  - Loss of consciousness
  - Severe, worsening headache
  - Neck pain
  - Seizures
  - Slurred speech
  - Repetitive vomiting
  - Severe drowsiness/ difficult arousal
  - Pupil asymmetry; double vision
  - Inability to recognize people/ places
  - Severe confusion, restlessness, agitation
  - Weakness/ numbness within arms or legs
  - Decreased coordination/ difficulty walking

* **Children**: more vague; head injury + child will not stop crying/ will not eat/ increasingly sleepy or difficult to arouse

* Remember: *symptoms may develop and evolve over first 24-48 hours* so close observation is recommended
Physician Evaluation

– Requires assessment of the person as a whole
  • Pre-injury function
    – Baseline school performance, personality, behavior
    – Medical History (ADHD, learning disorders, migraine HA, depression/ anxiety, etc.)
    – History of Concussions
  • Post-injury deficits
    – Patient and parent reported symptoms
    – School performance
    – Clinical Signs/ Symptoms
    – Neurocognitive testing

– Attempting to ascertain return to baseline function and personality post injury
– One of the most complicated sports medicine injuries to diagnose/ treat
– No single available test can either identify nor “clear” an individual from a concussion
Physician Evaluation

• Assessment (SCAT3 helpful)
  – Clinical symptoms
    • Somatic (headache, fatigue, dizziness, etc.)
    • Cognitive (attention/ memory/ concentration deficits, “in a fog”, slowed processing, etc.)
    • Emotional/ Behavioral (anger, depression, irritability etc.)
  – Physical Signs
    • Often reported by ATC/ medical personnel
    • Loss of consciousness
    • Amnesia
    • Balance/ coordination difficulties
    • Sleep Disturbances
    • Cognitive Impairments (poor school performance with testing/ homework; sideline evaluation)
Physician Evaluation

- **Assessment (continued)**
  - **Physical Examination**
    - General appearance, orientation, interactions/affect
    - Complete neurologic and musculoskeletal exam
    - Investigate *visual function* (acuity, tracking, etc.)
    - Assess ability to follow complex commands
    - Evaluate *postural instability* (balance deficits)
  - **Neurocognitive testing**
    - Recommended all athletes have clinical neuropsychological (NP) evaluation as part of overall management
    - Baseline NP testing not required but recommended
    - Variety of computer-based products (ImPACT, Concussion Vital Signs, etc.)
    - Baseline testing for ImPACT available to all Knox County School athletes
Immediate Post-Concussive Assessment and Cognitive Testing (ImPACT)

• Neuropsychological (NP) testing contributes significant information in the concussion evaluation; ImPACT is a neuropsychological test
• Cognitive recovery largely overlaps with symptom recovery, but in some cases it may precede or more commonly follow clinical symptom resolution
• NP Testing should not be the sole basis of management or return to play decisions.
  – Should be used in conjunction with a range of assessments of different clinical domains
• Per the 2012 Zurich Conference consensus statement: “It is recommended that all athletes should have a clinical neuropsychological assessment (including assessment of their cognitive function) as part of their overall management. This will normally be performed…in conjunction with computerized NP screening tools.”
• NP testing may be used to assist RTP decisions and is typically performed when an athlete is clinically asymptomatic; however, NP assessment may add important information in the early stages following injury for athletes returning to school.
• “It is also important to emphasize that ImPACT is not a diagnostic instrument and does not conclusively make return to sport/diagnostic decisions. These decisions should involve the judgment of trained health care professionals with specific knowledge of concussion management.”
ImPACT

- ImPACT does not yield one summary score, but rather a series of scores that have been demonstrated to be sensitive to concussion.
- ImPACT provides results in 5 key domains: Verbal Memory (reading/writing), Visual Memory (math/science), Visual Motor Speed, Reaction Time, Impulse Control Composite (measure of errors on the test).
  - The significant change from baseline values is assessed via the use of the Reliable Change Index (a range of normal values for a given domain).
  - Normative values for specific age groups and gender can be included in the report as well (percentile values) – calculated from 18,000 individuals (ages 10-59).
  - The test measures both Memory and Speed and can identify athletes who sacrifice one for the other (i.e. slowing down to get the correct answer for a question or speeding up to complete the test fast while sacrificing accuracy).
- It is important to emphasize that not all concussed athletes demonstrate clear evidence of cognitive dysfunction on neuropsychological testing.
- Not all cognitive deficits will be the same for each concussion.
- Non-cognitive symptoms such as headache, nausea, balance problems and dizziness are common and should be thoroughly assessed.
- The ImPACT test also contains a Post Concussive Symptom Inventory (PCSI) to provide an objective measure for symptom tracking.
  - Not used to diagnose concussions.
  - Provides a more objective measure for assessing symptom change across different periods of time (baseline, initial post-injury, follow-up evaluations).
<table>
<thead>
<tr>
<th>Symptom</th>
<th>Minor</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nausea</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Vomiting</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Balance Problems</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Dizziness</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Fatigue</td>
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<td>3</td>
</tr>
<tr>
<td>Trouble Falling Asleep</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sleeping More Than Usual</td>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sleeping Less Than Usual</td>
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<tr>
<td>Drowsiness</td>
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<td>3</td>
</tr>
<tr>
<td>Sensitivity to Light</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to Noise</td>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Irritability</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sadness</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nervousness</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling More Emotional</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Numbness or Tingling</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling Slowed Down</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling Mentally “Foggy”</td>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty Concentrating</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty Remembering</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Visual Problems</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
ImPACT - Modules

- The test itself is comprised of 6 distinct modules: (1) Word Memory, (2) Design Memory, (3) X' and O’s, (4) Symbol Match, (5) Color Match, (6) Three Letters

- **Word Memory** - Module 1
  - 12 target words are individually presented twice for the athlete to learn
  - Athlete then tested with 24 words (12 target and 12 non-target words) in a yes or no systemic fashion (non-target words sound and within same category as initial target word; i.e. ice/snow)
  - 5 different sets of the word list to minimize practice from one administration to the next
  - Delayed Recall: Following the administration of all other test modules (approximately 20 minutes), the subject is again tested for recall via the same method described above.

- **Design Memory** – Module 2
  - 12 target designs are individually presented twice for the athlete to learn
  - Athlete then tested with 24 designs (12 target and 12 non-target; may be same design rotated in space) in a yes or no systemic fashion
  - 5 different sets of designs used to minimize practice/learning from one administration to the next
  - Delayed Recall: Following the administration of all other test modules (approximately 20 minutes), the subject is again tested for recall via the same method as previously described
ImPACT - Modules

Word Memory

Design Memory
ImPACT - Modules

• **X’s and O’s (Module 3)**
  - Prior to the module beginning, a distractor task is given to interfere with memory rehearsal (task also used to assess reaction time)
    - Athlete asked to press a either the left or right button on the mouse when an object is present on the screen (i.e. press left with a blue square and right with a red circle); P and Q on the keyboard are substituted for computers that lack a mouse
    - Athlete practices the distractor task before the start of the module
  - Memory task: a random assortment of X’s and O’s is displayed for 2 seconds
  - For each trial, 3 of the X's and O’s are highlighted in yellow and the subject has to remember the location of the illuminated objects
    - Immediately after the X’s and O’s are present, the distractor task reappears on the screen
    - Following the distractor task, the X’s and O’s screen reappears and the athlete is asked to identify the previously 3 illuminated X’s and O’s
    - For each test administration, the athlete completes 4 trials of the task

• **Symbol Match (Module 4)**
  - Initially, the subject is presented with a grid that displays common symbols (triangle, square, arrow, etc) and directly under each symbol is a number button from 1 to 9
  - Below this grid, a symbol is presented.
  - The subject is required to click the matching number as quickly as possible and to remember the symbol/number of pairings
  - Correct performance is reinforced through the illumination of a correctly clicked number in **GREEN**. Incorrect performance illuminates the number button in **RED**.
  - Following the completion of 27 trials, the symbols disappear from the top grid. The symbols again appear below the grid and the subject is asked to recall the correct symbol/number pairing by clicking the appropriate number button.
Symbol Match Grid

PAY CLOSE ATTENTION AND REMEMBER WHICH NUMBER GOES WITH EACH SHAPE

Click on the number that corresponds to the following
• **Color Word Match** – Module 5
  – Athlete initially responds by clicking a red, blue or green button as they are presented on the screen. This procedure is completed to assure that subsequent trials would not be affected by color blindness
  – Next, a word is displayed on the screen in the same colored ink as the word (e.g. RED), or in a different colored ink (GREEN or BLUE)
  – The athlete is instructed to click in the box *as quickly as possible* only if the word is presented in the matching ink.

• **Three Letters** – Module 6
  – First, the athlete is allowed to practice a distracter task that consists of 25 numbered buttons on a 5x5 grid.
    - The subject is instructed to click as quickly as possible on the numbered buttons in backward order starting with “25.”
    - The position of the numbers on the grid are randomized after each trial to minimize practice effects.
  – The athlete is then presented with three consonant letters displayed on the screen.
  – Immediately following display of the 3 letters, the numbered grid re-appears and the subject is instructed to click the numbered buttons in backward order, again
  – After a period of 18 seconds, the numbered grid disappears and the subject is asked to recall the three letters by typing them from the keyboard.
  – Five trials for the task are presented for each test administration
You have completed 4 of 6 modules.

This is a test of SPEED OR REACTION TIME.

On the next screen, you will see the words RED, GREEN and BLUE presented one at a time. Click the word inside the box when it is shown in the same color in which it is written. Do not click the word when it is shown in a different color.

For example:

Click as fast as you can when you see one of these:

Do not click when you see these:

We will start with a sample of the test to familiarize you with the process.

Click the button below when you are ready to begin the sample.
# ImPACT – Clinical Report

## ImPACT\textsuperscript{R} Clinical Report

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Post-Injury 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exam Type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Date Tested</strong></td>
<td>04/09/2015</td>
<td>04/09/2015</td>
</tr>
<tr>
<td><strong>Last Concussion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Exam Language</strong></td>
<td>English</td>
<td>English</td>
</tr>
<tr>
<td><strong>Test Version</strong></td>
<td>2.1</td>
<td>2.1</td>
</tr>
</tbody>
</table>

### Composite Scores

<table>
<thead>
<tr>
<th><strong>Composite Scores</strong></th>
<th>Percentile scores if available are listed in small type.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory composite (verbal)</td>
<td>82 (49%)</td>
</tr>
<tr>
<td>Memory composite (visual)</td>
<td>78 (60%)</td>
</tr>
<tr>
<td>Visual motor speed composite</td>
<td>32.83 (32%)</td>
</tr>
<tr>
<td>Reaction time composite</td>
<td>0.61 (46%)</td>
</tr>
<tr>
<td>Impulse control composite</td>
<td>3 (46%)</td>
</tr>
<tr>
<td>Total Symptom Score</td>
<td>0 (46%)</td>
</tr>
</tbody>
</table>

**Cognitive Efficiency Index:**

- Baseline: 0.33
- Post-Injury 1: 0.17
• Can an athlete “sandbag” or “fake out” the ImPACT test to provide a falsely low interpretation?
  – For a variety of reasons, athletes will often not provide maximum effort when completing the ImPACT baseline testing

• Most Common Causes of Test Invalidity during Baseline?
  – Failure to properly read directions due to a reading disability or carelessness.
  – Attention deficit disorder and/or hyperactivity (ADD or ADHD).
  – Excessive fatigue (e.g. completion of testing after vigorous exercise).
  – “Horseplay”. This often occurs when athletes are not properly supervised or are placed too close together in a room.
  – Left-right confusion. This most often is evidenced by scores about 20 on the Impulse Control composite and is usually the result of the reversal of left and right on the X’s and O’s distracter task “Sandbagging” or poor performance to attempt to set a low baseline standard.

• To ensure optimum effort and valid baseline test results, ImPACT contains a validity index to identify test results that are not likely to reflect good effort.

• Independent research has noted an 89-95% success rate for the ImPACT test to detect “sandbagging” on baseline neurocognitive testing
Treatment

• **80-90% of concussions resolve in 1-2 weeks**
  – Prolonged symptoms within youth often observed and recent studies indicate that resolution in high school athletes may be up to 4 weeks

• Requires serial physician evaluations to assess improvement (In conjunction with ATC assessments)

• Varying degrees of **Physical/ cognitive rest** until symptom resolution critical in concussion management
  – Allows time for the brain to heal
  – “pushing through/ toughing it out” worsens symptoms
    • Acutely athlete at risk for serious/ life threatening injuries

• Rest followed by **graded return to exertional activity** prior to full medical clearance and full return to play

• Important to educate parents, staff, and coaches; **concussion symptoms not always apparent**
  – “He looks fine”; “I don’t see anything wrong with him”
  – Requires cooperation between all parties to provide comprehensive care for the student athlete
  – Keep athlete integrated in school setting as much as possible; must be normal academically before athletically
Physical Rest

- **Immediate exertion within the acute phase exacerbates concussion symptoms**
- Initial absolute physical rest (48-72 hours)
  - Patient withheld from all exertional activities (games, practices, conditioning, etc.)
  - **No physical education/ school exertional activities**
  - Rest within the home environment (bikes, sports, playground equipment, roller coasters, etc.)
- Failure to adhere to recommendations can result in prolonged or more severe symptoms
  - Risk of second impact and additional (structural) brain injury prior to resolution of concussion during acute phase
- Allow athlete to attend practices/ games as long as symptoms are not worsened
  - Athlete still checks in with coach/ ATC to remain integrated within the team
  - If symptoms worsen at practice, athlete returns home
- After period of initial rest, recent studies demonstrate light to moderate aerobic activity (without making symptoms worse) may actually improve recovery time
Cognitive Rest

• Over-stimulation of visual processing can potentially exacerbate symptoms

• **Relative cognitive rest** recommended
  – Avoidance of “rectangles/ screens”
    • Iphone (texting, Facebook, internet, etc.)
    • Ipad
    • Computers (other than what is necessary for school)
    • Television (limit exposure)
  – Academic Accommodations for homework, classroom assignments, testing

• Regular sleep schedule (no late nights/ sleep overs)
Academic Accommodations

KOC
Knoxville Orthopaedic Clinic

ACADEMIC ACCOMMODATIONS

Patient Name: ___________________________ Date of Evaluation: ____________

The student named above has suffered a concussion and is currently under the care of this clinic. He/she is not permitted to participate in any contact sport activity until formally cleared by this clinic.

The following academic accommodations may help in reducing the cognitive (thinking) load, thereby minimizing post-concussion symptoms and allowing the student to better participate in the academic process during the injury period. Needed accommodations may vary by course. The student and parent are encouraged to discuss and establish accommodations with the school on a class-by-class basis. The school and parent may wish to formalize accommodations through a 504 Plan if symptoms persist following treatment and need formalized accommodations.

- Testing: __________
  - extra time to complete tests
  - testing in a quiet environment
  - testing across multiple sessions
  - reduce length of tests
  - administer tests within passing grade;
  - refer to free resources to improve choice, or provide counseling

Students with concussion have increased memory and attention problems. They will not be able to learn as effectively or quickly as before. Furthermore, highly demanding activities like the above significantly raise symptoms (e.g., headaches, fatigue) which can in turn make testing more difficult.

- Note taking: Allow student to capture class notes or outlines ahead of time to aid organization and reduce multi-tasking demands. If this is not possible, allow the student to photocopy notes from in-class student.

Note taking may be difficult due to impaired multitasking abilities and increased symptoms.

- Workload reduction: reduce overall amount of make-up work, class work, and homework
  - typically recommend 50-75%, though may vary by class
  - avoid tests and projects.

It takes a concussed student much longer to complete assignments due to increased memory problems and decreased speed of learning. Recovery can be delayed when a student “pushing through” symptoms. Therefore, it is recommended that thinking or cognitive work be reduced. Just as physical exertion is reduced, extraneous or non-essential work might be reduced. The length of essay, have the student do every other problem in a homework assignment, or highlight key concepts only for testing while eliminating testing less important topics.

- Breaks: __________
  - Take breaks we needed to control symptom levels. For example, if headaches worsen during class, the student should put their head on the desk to rest. For worse symptoms, they may need to go to the nurse’s office to rest prior to returning to class.

- Extra Time: __________
  - Allow student to turn to assignments less.

Students may experience severe symptoms some daydreams and midnights. With increased symptoms, students are advised to rest and therefore may need to turn assignments in on a case by case basis.

Attendance Restrictions:

- Full days as scheduled
- Half-days as scheduled
- Limited Brooke’s education

- No school until __________

- Fall or partial days missed due to post-concussion symptoms should be medically excused.

Follow-up evaluation and revision of recommendations to occur.

Signature ________________________________

1422 Old Wengberger Road Knoxville, TN. 37909  865.558.4400  www.kocortho.com
Academic Accommodations

- **Modified school day** (if significantly symptomatic may need to temporarily avoid school or shorten the school day)
- **No testing the first week after injury**
- **Modified testing environment > 1 week**
  - Allow increased time/ reduce the length of the test
  - Break the test up into multiple segments
  - Minimize distractions (1 on 1; quiet room)
  - Change test presentation (read material to them, change test format)
- **Adjust homework and classroom assignments**
  - Allow student to obtain notes ahead of time
  - Lessen course load (classwork/ homework)
  - Increased time to turn in assignments
  - Tutoring sessions if necessary
- **Classroom modifications based on symptoms**
  - Allow individual to lay head down on desk or go to dark/ quiet room with symptom onset
- **Communication between all parties essential** (physician, athlete, parents, teachers) to ensure completion of course work and to prevent falling behind
Concussion School Support Team

- **The Student** – keep “in the loop” regarding progress and encourage to share symptoms; provides feedback
- **Parents/ Guardians** – education as to etiology, anticipated recovery, and treatment plan; observation in home environment
- **Physician/ Other Healthcare Professional** – maps out an individual plan for the returning student to manage cognitive and physical exertion
- **School Nurse** – periodic monitoring by the school nurse should continue as long as the concussion persists; often a liaison to parents and other school professionals
- **Teachers** – critical for reintegration within classroom
- **School Counselor/ Other Administrators** – often necessary for initiating a 504 plan or an IEP
- **Coaches/ Athletic Department Staff/ ATC**
- *It is important to identify someone on the team as the “case manager” who will have the primary role of advocating for the student’s needs and serve as the primary point of contact with the remainder of the team members*
Post-Concussive Syndrome

- **Persistent symptoms (>10 days) in 10-15% concussions;**
  - can last weeks to months
  - Memory and concentration problems
  - Mood swings (anxiety/ depression)
  - Personality changes
  - Headache
  - Fatigue
  - Dizziness
  - Insomnia/ excessive drowsiness

- **Activity avoidance during symptoms**
  - Some studies have demonstrated *low-level aerobic exercise* can be beneficial to patients with prolonged concussion symptoms

- May consider **pharmacologic intervention** to manage

- Additional therapy options available (vestibular rehab, speech/ language therapy, visual motor therapy, formal neuropsychological treatment, etc.)

- With repeated concussions or those that result in identifiable deficits, consideration given to ending sports participation
Return To Play (RTP)

- Comprehensive decision looking at youth as a whole within all domains (physical, cognitive, emotional, sleep) and within all environments
  - Complete symptomatic resolution required
  - Normal function within the home environment
  - Return to previous level of academic performance
    - Requires full school integration and course load
    - Athlete does NOT return to play if not fulfilling academic responsibilities
  - Normalization of clinical presentation/physical exam
  - Return to baseline/expected level of function with neurocognitive evaluation

- All parties agree that the athlete has returned to his previous level of function pre-concussion
- Often difficult to assess with prior medical history (ADHD, migraine HA, learning disorders, anxiety/depression, etc.)
- If treatment has required new medications for symptoms, these must be removed before RTP
TSSAA Gradual Return to Play Plan

- **Day 1:** Low levels of physical activity
  - Walking, light jogging, light stationary biking
  - **Light weightlifting** (low weight/ moderate reps; no bench; no squat)

- **Day 2:** Moderate levels of physical activity with body/ head movement
  - Moderate jogging, brief running, moderate intensity on the stationary cycle
  - Moderate intensity weight-lifting (reduce time/ weight from typical routine)

- **Day 3:** Heavy non-contact physical activity
  - Sprinting/ running, high intensity stationary cycling, regular lifting routine
  - **Non-contact sport specific drills** (agility with 3 planes of movement)
TSSAA Gradual Return to Play Plan (continued)

- **Day 4**: Sports Specific practice
- **Day 5**: Full contact in a controlled drill/practice
- **Day 6**: Return to competition

- Pay careful attention to athlete symptoms and thinking/concentration skills at each stage/activity.
- After completing each step *without recurrence of symptoms*, move to *next level of activity the next day*.
- If symptoms return, let health care provider know, return to first level and restart the program gradually.

*Physician must sign the TSSAA Concussion Return To Play Form for “cleared for full participation in all activities without restriction”*
# TSSAA Return to Play Form

**TSSAA CONCUSSION RETURN TO PLAY FORM**

This form is adapted from the Acute Concussion Evaluation (ACE) care plan or the CDC website (www.cdc.gov/injury). All medical providers are encouraged to review this title if they have questions regarding the latest information on the evaluation and care of the school athlete following a concussion injury. Please follow any recommendations that you believe.

<table>
<thead>
<tr>
<th>Athlete's name:</th>
<th>Date of Birth:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Injury:</td>
<td></td>
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</tbody>
</table>

This return to play plan is based on today's evaluation.

<table>
<thead>
<tr>
<th>Date of Evaluation:</th>
<th>Return to office care/time:</th>
<th>Return to school or (date):</th>
</tr>
</thead>
</table>

**RETURN TO SPORTS:**

1. Athletes should not return to practice or play the same day that their head injury occurred.
2. Athletes should never return to play or practice if they still have ANY symptoms.
3. Athletes, let sure that your coach and/or athletic trainer are aware of your injury, symptoms, and have the contact information for the treating health care provider.

The following are the return to sports recommendations at the present time:

- **PHYSICAL EDUCATION:**
  - **Do Not Return to PE class at this time.**
  - **May Return to PE class.**

- **SPORTS:**
  - **Do not return to sports practice or competition at this time.**
  - **May gradually return to sports practice under the supervision of the health care provider for your school or team.**
  - **May be advanced back to competition after phone conversation with treating health care provider.**
  - **Must return to the treating health care provider for final clearance to return to competition.**

- **OR:**
  - **Clear for full participation in all activities without restrictions.**

**TREATING HEALTH CARE PROVIDER INFORMATION (Please Print/Stamp)**

Please check:

- Medical Doctor (M.D.)
- Osteopath (D.O.)
- Clinical Neuropsychologist/Concussion expert

Provider's Name: ____________________________
Provider's Office Phone: ______________________
Provider's Signature: _________________________
Office Address: _______________________________

**Graded Return to Play Plan**

Return to play should occur in gradual steps beginning with light aerobic exercise only to increase your heart rate (e.g., stationary cycle); moving to increasing your heart rate with movement (i.e., running); then adding intermittent contact if appropriate; and finally return to sports competition.

Your careful attention to your symptoms and your willingness and cooperation with each stage of activity is of utmost importance. Any symptoms of the injured area that occur during each stage of activity should be reported to the health care provider.

**Stage 1:** Light levels of physical activity (i.e., symptoms do not occur during or after the activity): This includes walking, light jogging, light stationary cycling, and light weightlifting (low weight – moderate reps, no weight, no strain).

**Stage 2:** Moderate levels of physical activity (i.e., symptoms do not occur during or after the activity): This includes moderate jogging, light running, moderate intensity in the stationary cycle, moderate intensity weightlifting (low weight – reduced weight from your specific sport).

**Stage 3:** Heavily non-contact physical activity (i.e., symptoms do not occur during or after the activity): This includes swimming/training, high intensity stationary cycling, swimming the regular lifting routine, non-contact sport specific drills – with 3 proven movements.

**Stage 4:** Specific sport practice.

**Stage 5:** Full contact in a controlled skill or elective.

**Stage 6:** Return to competition.
Second Impact Syndrome (SIS)

- Athlete sustains second head injury before the first is fully resolved
- Acute, rapid and often fatal brain swelling
  - Thought to cause vascular congestion and increased intracranial pressure
  - May be difficult or impossible to control (death within minutes)
  - Loss of consciousness is not a requirement for this condition
  - Incidence not well documented within the literature
- May occur days/weeks after the initial head injury
- The CDC reports an average of up to 3 deaths per year from sports related concussive injuries
- Often concussion (usually undiagnosed) had occurred prior
- Review of the literature notes over 13 year period 94 football related “catastrophic head injuries” (brain bleeding/edema)
  - 92 at the high school level
  - 71% with previous concussion same season
  - 39% still playing with residual symptoms
- Aside from SIS, repetitive head injuries can have long term effects on cognitive and physical functioning
  - Chronic Traumatic Encephalopathy (poorly understood)
Concussion Prevention

• **Basic:**
  - Buckling child in car properly (child safety seat, booster seat, seat belt)
  - Wearing a properly fitting helmet (bike, scooter, motorcycle, horse-riding, skiing, etc.)
  - Home – window guards, safety gates, etc.
  - Playground – shock absorbing surface material

• **Sports:**
  - *No piece of equipment has been proven to prevent concussions* or reduce the likelihood of occurrence (helmet, mouth-guard, etc.)
  - American Academy of Neurology study indicates helmets effective at preventing catastrophic injuries (skull fractures/ brain bleeds); *lousy on preventing concussions* (specific ones may be less lousy than others though)
    - Virginia Tech Helmet Ratings (Riddell, Rawlings, Zenith, Schutt, Adams)
      - 5 star system: Virginia Tech/ Wake Forest University School of Biomedical Engineering and Sciences
    - National Operating Committee for Standards of Athletic Equipment (NOCSAE)
      - Pass/ Fail System; gold standard of head injury prevention (no skull fracture since implementation)
  - *Teach proper technique, encourage strengthening of neck and shoulder muscles, enforce rules against head first contact*
  - Make sure helmet fits properly and is appropriate for the position/ sport
Take Home Points

• A concussion is a functional not structural injury
• Learn to recognize signs and symptoms of a concussion
  – Remember a concussion is often an evolving injury
• If suspected, be conservative and remove individual from activity immediately
• Do not let concussed youth return to play unless properly evaluated and cleared
• Use a team approach for concussion management and academic reintegration
• There is no absolute concussion prevention!
Practical Resources

- CDC – Concussion and Mild Traumatic Brain Injury
  - http://www.cdc.gov/Concussion/
- CDC – Returning to School After a Concussion
- Zurich 4th International Conference on Concussion in Sport (Consensus Statement)
  - http://bjsm.bmj.com/content/47/5/250.full
- Sport Concussion Recognition Tool
  - http://bjsm.bmj.com/content/47/5/267.full.pdf
- Sport Concussion Assessment Tool (SCAT3)
  - http://bjsm.bmj.com/content/47/5/259.full.pdf
- Child Sport Concussion Assessment Tool (Child SCAT3)
  - http://bjsm.bmj.com/content/47/5/263.full.pdf
- Tennessee Sports Concussion Law
  - http://health.state.tn.us/tbi/concussion.htm
- The Concussion Blog (practical information and resources)
  - http://theconcussionblog.com