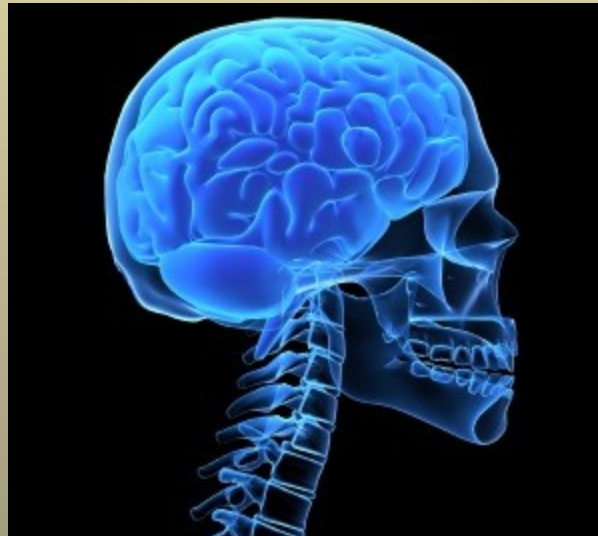


# Current Concepts in Sports Concussion: Opportunities for the Physical Therapist

## Concussion in Sport



# Current Concepts in Sports Concussion: Opportunities for the Physical Therapist

Concussion Management:  
Planning & Immediate Physical  
Assessment

# Concussion Management: Planning & Immediate Physical Assessment

- Objectives:
  - Examine the components of a Concussion Management Plan
  - Identify & understand best practices for post-concussion assessment
  - Review previous & current concussion grading / classification scales
  - Review literature involving common standardized assessment tools / instruments

# Concussion Focus & Awareness

- International Symposia on Concussion in Sport
  - Vienna: 2001
  - Prague: 2004
  - Zurich: 2008
  - \*\*\*\*\*: December 2012
- Positions endorsed by:
  - American College of Sports Medicine (ACSM)
  - American Academy of Family Physicians (AAFP)
  - American Academy of Orthopaedic Surgeons (AAOS)
  - American Medical Society for Sports Medicine (AMSSM)
  - American Orthopaedic Society for Sports Medicine (AOSSM)
  - American Osteopathic Academy for Sports Medicine (AOASM)
- Centers for Disease Control & Prevention



**The NCAA Executive Committee adopted (April 2010) the following policy for institutions in all three divisions.**

“Institutions shall have a concussion management plan on file such that a student-athlete who exhibits signs, symptoms or behaviors consistent with a concussion shall be removed from practice or competition and evaluated by an athletics healthcare provider with experience in the evaluation and management of concussions. Student-athletes diagnosed with a concussion shall not return to activity for the remainder of that day. Medical clearance shall be determined by the team physician or his or her designee according to the concussion management plan.

**The NCAA Executive Committee adopted (April 2010) the following policy for institutions in all three divisions.**

“In addition, student-athletes must sign a statement in which they accept the responsibility for reporting their injuries and illnesses to the institutional medical staff, including signs and symptoms of concussions. During the review and signing process, student-athletes should be presented with educational material on concussions.”

## **NCAA Adopted Concussion Management Plan Legislation.**

**Concussion Management Plan.** An active member institution shall have a concussion management plan for its student-athletes. The plan shall include, but is not limited to, the following:

- (a)** An annual process that ensures student-athletes are educated about the signs and symptoms of concussions. Student-athletes must acknowledge that they have received information about the signs and symptoms of concussions and that they have a responsibility to report concussion-related injuries and illnesses to a medical staff member;
- (b)** A process that ensures a student-athlete who exhibits signs, symptoms or behaviors consistent with a concussion shall be removed from athletics activities (e.g., competition, practice, conditioning sessions) and evaluated by a medical staff member (e.g., sports medicine staff, team physician) with experience in the evaluation and management of concussions;
- (c)** A policy that precludes a student-athlete diagnosed with a concussion from returning to athletic activity (e.g., competition, practice, conditioning sessions) for at least the remainder of that calendar day; and
- (d)** A policy that requires medical clearance for a student-athlete diagnosed with a concussion to return to athletics activity (for example, competition, practice, conditioning sessions) as determined by a physician (e.g., team physician) or the physician's designee.

**3.2.4.16.1 Effect of Violation.** A violation of Constitution 3.2.4.16 shall be considered an institutional violation per Constitution 2.8.1; however, the violation shall not affect the student-athlete's eligibility.



# Concussion Management Plan

## **Describes comprehensive management**

- Similar to other management / emergency management plans:
  - Spine injury, sickle cell, heat illness, cardiac arrest, etc.

## **Communication : Planning : Practice**

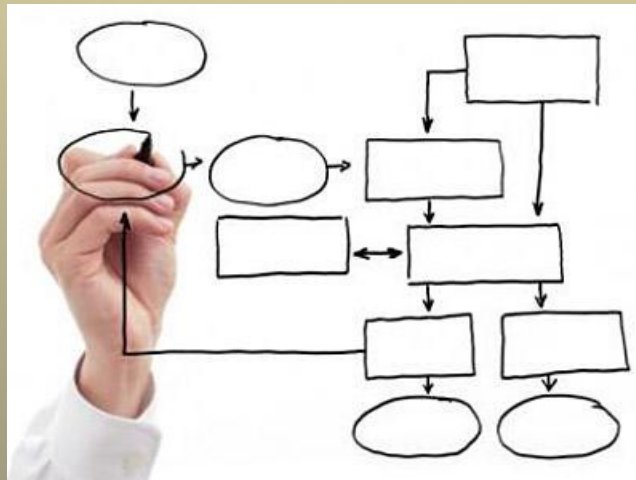
- Who will be responsible for the on-field response?
- Who will conduct the emergency assessment and handle communication if advanced help is needed?
- Who will observe the athlete on the sideline following injury?
- Who will make a concussion diagnosis or return-to-play decision, especially in the absence of a physician?
- Who will communicate the diagnosis and prognosis with the parents and coaches?



# Concussion Management Plan

- NCAA Committee on Competitive Safeguards and Medical Aspects of Sports ([CSMAS](#))
- NCAA Health & Safety

## [Best Practices for a Concussion Management Plan](#)



# Concussion Management Plan

## Sample Concussion Management Plans:

[University of Georgia](#)



[University of North Carolina](#)



[Princeton University](#)



[UCF](#)



# Immediate Physical Assessment

## Identification Challenges:

- athletes hiding symptoms
- most show no outward signs
- 9-10% involve loss of consciousness



# Immediate Physical Assessment

## On-the-field assessment

- “primary survey”: follows emergency management plan
  - Airway – Breathing – Circulation
  - Spine



# Immediate Physical Assessment

## Sideline assessment

- “secondary survey”
  - Major components:
    - Measures of concussion-related symptoms
    - Balance
    - Neuropsychological testing
  - 7-step process to include history, observation, palpation, special tests, range of motion (ROM) tests, strength tests, and functional tests

# Sideline Assessment

- History: injury often witnessed or can be described by teammates
- History / Observation: consciousness; can also determine anterograde / retrograde amnesia
  - Who was the person who walked you to the sideline after the hit? Or word recall (Anterograde)
  - What did you have for lunch? (Retrograde)



# Sideline Assessment

- [Graded Symptom Checklist:](#)

Number, type, severity of symptoms

- 83% Headaches
- 65% Dizziness
- 57% Confusion



- Additional Observation & Examination



# Sideline Assessment

- Special Tests
  - Cranial nerve integrity
  - Neuropsychological function
  - Balance



- Standardized Assessment of Concussion
  - addresses neuropsych. status “on sideline”

# Immediate Transport

- Deterioration of neurologic function
- Decreasing level of consciousness
- Decrease or irregularity in respirations
- Decrease or irregularity in pulse
- Unequal, dilated, or unreactive pupils
- Any signs or symptoms of associated injuries, spine or skull fracture, or bleeding
- Mental-status changes: lethargy, difficulty maintaining arousal, confusion, agitation
- Seizure activity

Guskiewicz KM, Bruce SL, Cantu RC, et al. National Athletic Trainers' Association Position Statement: management of sport-related concussion. *J Athl Train* 2004;29:280–97.

# Day-of-Injury Referral

- Loss of consciousness on the field
- Amnesia lasting longer than 15 minutes
- Increase in blood pressure
- Cranial-nerve deficits
- Vomiting
- Motor deficits subsequent to initial on-field assessment
- Sensory deficits subsequent to initial on-field assessment
- Balance deficits subsequent to initial on-field assessment
- Cranial-nerve deficits subsequent to initial on-field assessment
- Post-concussion symptoms that worsen
- Additional post-concussion symptoms as compared with those on the field
- Athlete is still symptomatic at the end of the game (especially at high school level)

Guskiewicz KM, Bruce SL, Cantu RC, et al. National Athletic Trainers' Association Position Statement: management of sport-related concussion. *J Athl Train* 2004;29:280–97.

# Delayed Referral

## After the Day of Injury

- Any of the findings in the day-of-injury referral category
- Post-concussion symptoms worsen or do not improve over time
- Increase in the number of post-concussion symptoms reported
- Post-concussion symptoms begin to interfere with the athlete's daily activities
  - (i.e., sleep disturbances, cognitive difficulties)

Guskiewicz KM, Bruce SL, Cantu RC, et al. National Athletic Trainers' Association Position Statement: management of sport-related concussion. *J Athl Train* 2004;29:280–97.

# Resource Tools for Assessment

- [Graded Symptom Checklist \(GSC\)](#)

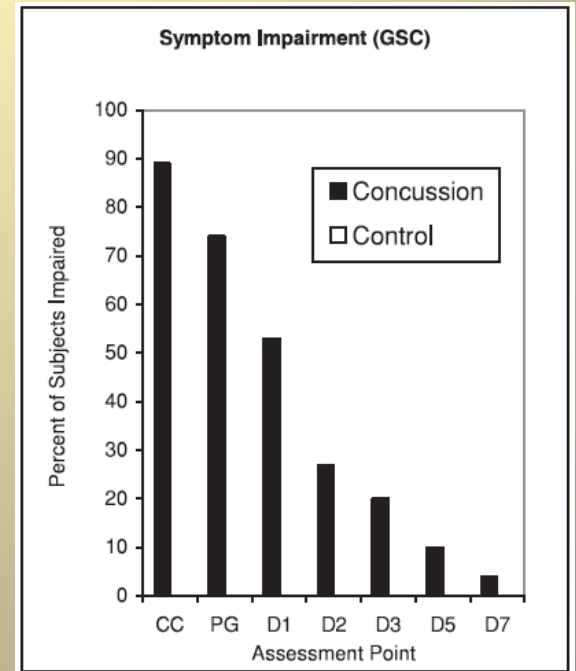
## Concussion Diagnosis

89% sensitivity, 100% specificity (day of)

...comparing concussed vs. non-concussed athletes

\*Sensitivity declines (.04), specificity relatively same (1.00)

\*Study based on 94 concussed NCAA football athletes



McCrea M, Barr WB, Guskiewicz KM, et al. Standard regression-based methods for measuring recovery after sport-related concussion. J Int Neuropsychol Soc 2005;11:58–69.

# Resource Tools for Assessment

- Standardized Assessment of Concussion (SAC)
  - 6-8 minutes to administer
  - 5 sections:
    - Orientation
    - Immediate memory
    - Concentration
    - Delayed recall
    - Gross neurological deficiencies

# Resource Tools for Assessment

- [Standardized Assessment of Concussion \(SAC\)](#)
  - Concussion Diagnosis
    - 94% sensitivity, 76% specificity
      - ...when 1-point drop from **baseline**

Barr WB, McCrea M. Sensitivity and specificity of standardized neurocognitive testing immediately following sports concussion. J Int Neuropsychol Soc 2001; 7:693–702.



# Resource Tools for Assessment

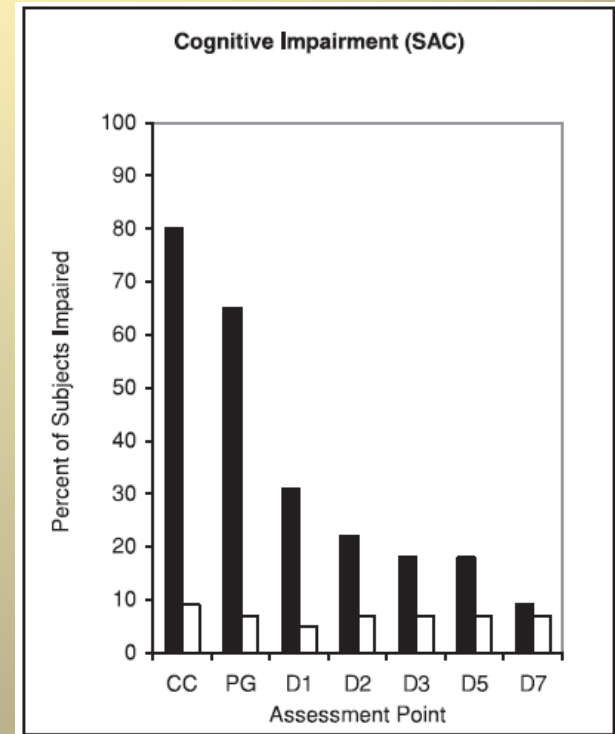
- Standardized Assessment of Concussion (SAC)

## Concussion Diagnosis

80% sensitivity, 91% specificity (day of)  
...comparing concussed vs. non-concussed athletes

\*Sensitivity declines (.02), specificity relatively same (.98)

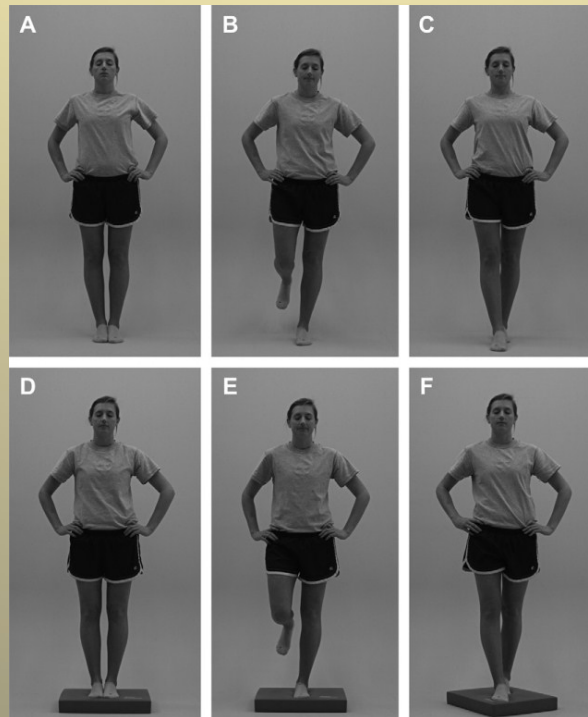
\*Study based on 94 concussed NCAA football athletes



McCrea M, Barr WB, Guskiewicz KM, et al. Standard regression-based methods for measuring recovery after sport-related concussion. J Int Neuropsychol Soc 2005;11:58–69.

# Resource Tools for Assessment

- Balance Error Scoring System (BESS)
  - standardized clinical balance test
  - Minimal resources, easy to deliver



# Resource Tools for Assessment

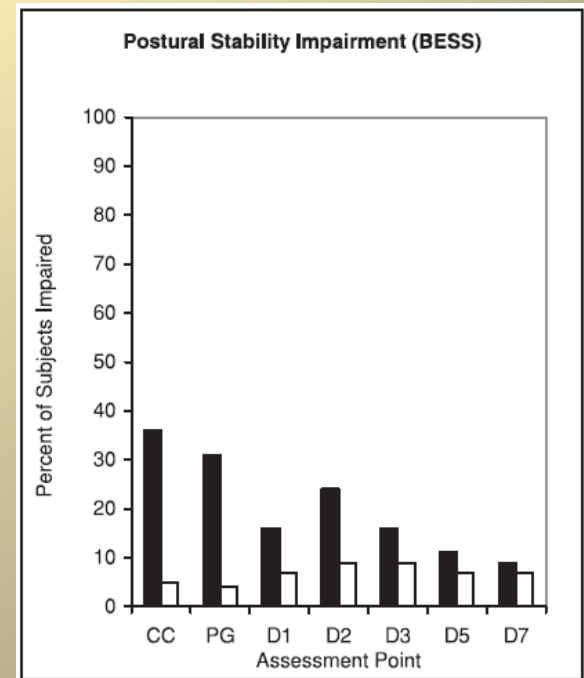
- Balance Error Scoring System (BESS)

## Concussion Diagnosis

34% sensitivity, 91% specificity

\*Sensitivity declines (.07), specificity same (.95)

\*Study based on 94 concussed NCAA football athletes



McCrea M, Barr WB, Guskiewicz KM, et al. Standard regression-based methods for measuring recovery after sport-related concussion. J Int Neuropsychol Soc 2005;11:58–69.

# Resource Tools for Assessment

- [Balance Error Scoring System \(BESS\)](#)
- Interrater reliability
  - Total Score (.74)                      Components (.47-.83)
  - CI (.58-.88)                              MDC: 9.4 points
- Intrarater reliability
  - Total Score (.57)                      Components (.44-.83)
  - CI (.36-.74)                              MDC: 7.3 points

# Resource Tools for Assessment

## Standardized Concussion Assessment Tool II (SCAT II)

- **SCAT II**: developed / endorsed 2008 at Consensus Statement on Concussion in Sport – the 3<sup>rd</sup> International Conference on Concussion in Sport held in Zurich, November 2008
  - Addition of: Glasgow Coma Scale (GCS), Maddocks Score, and a balance examination
- SCAT I: developed in 2004
  - SAC, graded symptom checklist, cognitive assessment, brief physical examination, & patient education section
  - includes immediate & delayed memory, concentration, and neurological screen sections
  - physical examination section: assessment of speech fluency, cranial nerves, pronator drift, and a gait analysis

# Resource Tools for Assessment

## Standardized Concussion Assessment Tool II (SCAT II)

- **No established validity / reliability**
- **Normative data studies starting to be published**
  - Jinguji, TM, Bompadre, V, Harmon, KG, Satchell, EK, Gilbert, K, Wild, J, Eary, JF. Sport Concussion Assessment Tool - 2: Baseline Values for High School Athletes. British Journal of Sports Medicine. 2012; 46 (5): 365.

**Table 1** SCAT2 results summary

Test Domain	Average	Score possible	SD ( $\pm$ )
Symptom score	19.75	22.00	3.28
Physical signs score	2.00	2.00	0.00
Glasgow Coma Scale	15.00	15.00	0.00
Balance score	25.82	30.00	3.45
Coordination	0.90	1.00	0.30
<b>Subtotal</b>	<b>63.46</b>	<b>70.00</b>	<b>4.90</b>
Orientation	4.79	5.00	0.57
Immediate memory score	13.82	15.00	1.75
Concentration score	2.96	5.00	1.33
Delayed recall	3.96	5.00	1.11
<b>SAC subtotal</b>	<b>25.52</b>	<b>30.00</b>	<b>3.06</b>
<b>SCAT2 total</b>	<b>88.99</b>	<b>100.00</b>	<b>7.96</b>

SCAT2, Sport Concussion Assessment Tool.  
SD, standard deviation.

# Resource Tools for Assessment

## Standardized Concussion Assessment Tool II (SCAT II)

**Table 2** SCAT2 scores summarised by age and sex

SCAT2	Age 13–15 mean (SD) (N=111)		Age 16–19 mean (SD) (N=103)		Overall mean (SD) (N=214)	
	Female (N=28)	Male (N=83)	Female (N=31)	Male (N=72)	Female (N=59)	Male (N=155)
Symptom score	20.89 (2.79)	20.14 (2.43)	18.59 (4.74)	19.37 (3.38)	19.64(4.10)	19.79(2.92)
Physical signs	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)
Glasgow Coma Scale	15.00 (0.00)	15.00 (0.00)	15.00 (0.0)	15.00 (0.00)	15.00 (0.00)	15.00 (0.00)
Balance score	27.41 (2.14)	25.25 (3.51)	26.38 (3.00)	25.65 (3.78)	26.85 (2.67)	25.43 (3.63)
Coordination	0.96 (0.19)	0.92 (0.30)	0.91 (0.30)	0.85 (0.36)	0.93 (0.25)	0.88 (0.32)
<b>Subtotal</b>	<b>66.26 (3.44)</b>	<b>63.31 (4.45)</b>	<b>62.88 (5.42)</b>	<b>62.87 (5.27)</b>	<b>64.42 (4.89)</b>	<b>63.10 (2.79)</b>
Orientation	4.85 (1.61)	4.67 (0.66)	4.88 (0.34)	4.86 (0.54)	4.86 (0.39)	4.75 (0.62)
Immediate memory score	14.15 (1.61)	13.71 (1.41)	14.44 (0.98)	13.55 (2.29)	14.31 (1.30)	13.64 (1.86)
Concentration score	3.00 (1.00)	2.67 (1.32)	3.63 (1.13)	2.99 (1.45)	3.34 (1.11)	2.81 (1.39)
Delayed recall	4.07 (1.24)	4.01 (1.02)	3.72 (1.28)	4.01 (1.09)	3.88 (1.26)	3.99 (1.05)
<b>SAC subtotal</b>	<b>26.07 (3.02)</b>	<b>25.06 (2.50)</b>	<b>26.67 (2.59)</b>	<b>25.41 (3.69)</b>	<b>26.39 (4.87)</b>	<b>25.19 (3.10)</b>
<b>SCAT2 total</b>	<b>92.33 (4.29)</b>	<b>88.37 (5.49)</b>	<b>89.55 (6.47)</b>	<b>88.28 (6.39)</b>	<b>90.81 (5.71)</b>	<b>88.29 (5.90)</b>

Values in parenthesis are SDs.

SAC, Standardised Assessment of Concussion; SCAT2, Sport Concussion Assessment Tool – 2.



# Resource Tools for Assessment

## Standardized Concussion Assessment Tool II (SCAT II)

**Table 4** Concentration score summary by age, sex and overall total

<b>Age</b>	<b>13–15 years</b>		<b>16–19 years</b>	
<b>Sex</b>	<b>Female (N=28)</b>	<b>Male (N=83)</b>	<b>Female (N=31)</b>	<b>Male (N=72)</b>
3 digits (%)	100.00	95.24	96.88	88.73
4 digits (%)	78.00	69.05	90.63	78.87
5 digits (%)	44.44	36.90	59.38	36.63
6 digits (%)	14.81	11.90	28.13	21.13
Months of the year (%)	59.26	57.14	84.38	70.42

Jinguji, TM, Bompadre, V, Harmon, KG, Satchell, EK, Gilbert, K, Wild, J, Eary, JF. Sport Concussion Assessment Tool - 2: Baseline Values for High School Athletes. British Journal of Sports Medicine. 2012; 46 (5): 365.

# Resource Tools for Assessment

## Standardized Concussion Assessment Tool II (SCAT II)

**Table 5** SCAT2 scores by sport

	Baseball	Basketball	Football	Gymnastics	Soccer women	Softball	Track
SCAT2 composites	Average (SD)	Average (SD)	Average (SD)	Average (SD)	Average (SD)	Average (SD)	Average (SD)
Age	17.1	16.2	15.1	15.6	15.4	16.4	17.2
Symptoms score	18.18 (3.9)	20.5 (2.2)	19.89 (2.5)	17.63 (4.9)	20.07 (3.8)	21 (0.8)	18.9 (4.4)
Physical signs	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)
Glasgow Coma Scale	15 (0.00)	15 (0.00)	15 (0.00)	15 (0.00)	15 (0.00)	15 (0.00)	15 (0.00)
Balance	25.36 (3.96)	26.45 (3.18)	24.76 (3.67)	27.75 (2.31)	27.07 (3.04)	27.2 (1.69)	26.18 (3.02)
Coordination	0.82 (0.4)	0.85 (0.37)	0.9 (0.3)	1.00 (0.00)	0.93 (0.26)	1.00 (0.00)	0.82 (0.39)
<b>Subtotal</b>	<b>61.36 (6.22)</b>	<b>64.80 (4.55)</b>	<b>62.54 (4.79)</b>	<b>63.38 (4.93)</b>	<b>65.07 (4.82)</b>	<b>66.27 (1.62)</b>	<b>62.93 (5.05)</b>
Orientation	5 (0.0)	4.75 (0.44)	4.67 (0.69)	4.88 (0.35)	4.86 (0.42)	4.8 (0.42)	5 (0.47)
Immediate memory	13.27 (2.0)	13.2 (2.0)	13.82 (1.33)	14.75 (0.46)	14.43 (0.80)	13.7 (1.25)	13.36 (3.23)
Concentration score	3.73 (1.1)	3.35 (1.23)	2.57 (1.34)	3.00 (0.76)	3.55 (1.25)	3.1 (1.2)	2.75 (1.35)
Delayed recall	3.73 (1.01)	3.55 (1.1)	4.12 (1.01)	4.50 (0.76)	4.26 (0.96)	3.8 (1.14)	3.25 (1.4)
<b>SAC subtotal</b>	<b>25.73 (3.17)</b>	<b>24.85 (2.89)</b>	<b>25.18 (2.64)</b>	<b>27.13 (1.25)</b>	<b>27.10 (2.16)</b>	<b>25.27 (1.62)</b>	<b>24.36 (4.98)</b>
<b>Overall score</b>	<b>87.09 (7.55)</b>	<b>89.65 (5.2)</b>	<b>87.72 (5.98)</b>	<b>90.5 (5.27)</b>	<b>92.17 (4.48)</b>	<b>91.6 (2.12)</b>	<b>87.29 (6.79)</b>
N=	11	20	94	8	42	11	28

Parentheses show SD of values.

SAC, Standardised Assessment of Concussion; SCAT2, Sport Concussion Assessment Tool.

Jinguji, TM, Bompadre, V, Harmon, KG, Satchell, EK, Gilbert, K, Wild, J, Eary, JF. Sport Concussion Assessment Tool - 2: Baseline Values for High School Athletes. British Journal of Sports Medicine. 2012; 46 (5): 365.

# Resource Tools for Assessment

## Standardized Concussion Assessment Tool II (SCAT II)

**Table 6** Concentration score by sport participation

	<b>Baseball</b>	<b>Basketball</b>	<b>Football</b>	<b>Gymnastics</b>	<b>Soccer</b>	<b>Softball</b>
<b>Concentration</b>	<b>Average (SD)</b>	<b>Average (SD)</b>	<b>Average (SD)</b>	<b>Average (SD)</b>	<b>Average (SD)</b>	<b>Average (SD)</b>
3-digits recall	1 (0.0)	1 (0.0)	0.91 (0.28)	1.00 (0.00)	1.00 (0.00)	0.9 (1.32)
4-digits recall	1 (0.0)	0.8 (0.41)	0.66 (0.48)	0.75 (0.46)	0.93 (0.26)	0.8 (0.42)
5-digits recall	0.63 (0.50)	0.4 (0.50)	<b>0.32 (0.47)</b>	0.25 (0.46)	0.59 (0.49)	0.4 (0.52)
6-digits recall	0.27 (0.46)	0.20 (0.41)	<b>0.13 (0.33)</b>	0.12 (0.35)	0.26 (0.44)	0.3 (0.48)
Months of the Year	0.81 (0.40)	0.8 (0.41)	<b>0.55 (0.5)</b>	0.87 (0.35)	0.79 (0.41)	0.7 (0.48)

Parentheses show SD of values.

# Concussion Grading Scales

Guideline	Grade 1 (Mild)	Grade 2 (Moderate)	Grade 3 (Severe)
Congress of Neurological Surgeons	<ol style="list-style-type: none"> <li>1. No loss of consciousness</li> <li>2. Transient neurological disturbance</li> </ol>	<ol style="list-style-type: none"> <li>1. Loss of consciousness with complete recovery in less than 5 minutes</li> </ol>	<ol style="list-style-type: none"> <li>1. Loss of consciousness lasts longer than 5 minutes</li> </ol>
Cantu	<ol style="list-style-type: none"> <li>1. No loss of consciousness</li> <li>1. Post-traumatic amnesia, signs/symptoms last longer than 30 minutes</li> </ol>	<ol style="list-style-type: none"> <li>1. Loss of consciousness lasts less than 1 minute</li> <li>2. Post-traumatic amnesia, signs/symptoms last longer than 30 minutes but less than 24 hours</li> </ol>	<ol style="list-style-type: none"> <li>1. Loss of consciousness lasts more than 1 minute</li> <li>2. Post-traumatic amnesia lasts longer than 24 hours</li> <li>3. Signs/symptoms last longer than 7 days</li> </ol>
Colorado Medical Society	<ol style="list-style-type: none"> <li>1. Confusion without amnesia</li> <li>2. No loss of consciousness</li> </ol>	<ol style="list-style-type: none"> <li>1. Confusion with amnesia</li> <li>2. No loss of consciousness</li> </ol>	<ol style="list-style-type: none"> <li>1. Loss of consciousness (of any duration)</li> </ol>
American Academy of Neurology	<ol style="list-style-type: none"> <li>1. Transient confusion</li> <li>2. No loss of consciousness</li> <li>3. Symptoms, mental status changes resolve in less than 5 minutes</li> </ol>	<ol style="list-style-type: none"> <li>1. Transient confusion</li> <li>2. No loss of consciousness</li> <li>3. Symptoms, mental status changes last longer than 15 minutes</li> </ol>	<ol style="list-style-type: none"> <li>1. Loss of consciousness (brief or prolonged)</li> </ol>

- Cantu R. Posttraumatic retrograde and anterograde amnesia: pathophysiology and implications in grading and safe return to play. . J Athl Train. 2001;36:244-248.
- Maroon JC, Lovell MR, Norwig J, Podell K, Powell JW, Hartl R. Cerebral concussion in athletes: evaluation and neuropsychological testing. Neurosurgery. 2000 Sep;47(3):659-69; discussion 69-72.
- Lovell M, Collins M, Bradley J. Return to play following sports-related concussion. Clin Sports Med. 2004 Jul;23(3):421-41, ix.



# Current Concepts in Sports Concussion: Opportunities for the Physical Therapist

Concussion Management:  
Follow-up Management &  
Reassessment

# Follow-up Management & Reassessment

- Objectives:
  - Examine principles & components of the post-concussion management plan
  - Review all facets of the interdisciplinary reassessment process
  - Understand importance of comprehensive baseline testing & relate to reassessment



# Follow-up Management & Reassessment

## Concussion Management Plan

- Management plan:: REST is Key!
  - Physical & Cognitive
  
- Follow plan's procedure for plan of care & reassessment

- [UCF](#)
- [UGA](#)





# Follow-up Management & Reassessment

## Concussion Management Plan - UNC

### Concussion Assessment:

NO ATHLETE SUSPECTED OF HAVING A CONCUSSION IS PERMITTED TO RETURN TO PLAY THE SAME DAY, AND NO ATHLETE IS PERMITTED TO RETURN TO PLAY WHILE SYMPTOMATIC FOLLOWING A CONCUSSION.

- **Baseline testing:** conducted on each athlete upon entering as a first-year student, transfer, or for those athletes sustaining a concussion the previous season (re-baseline);
- **Time of Injury:** clinical evaluation & symptom checklist;
- **1-3 hrs post-injury:** symptom checklist; referral if necessary;
- **Next Day:** follow-up clinical evaluation & symptom checklist;
- **Follow-up evaluations daily to track symptom recovery;**
- **Once athlete becomes *asymptomatic*:**
  1. Determine where athlete is relative to baseline on the following measures.
    - a. Symptom Assessment (Graded Symptom Checklist)
    - b. Mental Status Assessment (Standardized Assessment of Concussion)
    - c. Neuropsychological Assessment (CNS Vital Signs)
    - d. Balance Assessment (Balance Error Scoring System & NeuroCom SOT)



# Follow-up Management & Reassessment

## Concussion Management Plan – UNC

2. If the measures (a-d) listed above are at least 95% of baseline scores and the athlete remains asymptomatic for **1 additional day** following these tests, the physician can instruct the athletic trainer to begin a *5-step graduated exertional return to play (RTP) protocol* (see below) with the athlete to assess for increasing signs and symptoms. Symptoms should be reassessed immediately following exertional activities.

\*\*95% of baseline

\*\* 1 additional day rest / asymptomatic



# Comprehensive Assessment

**Table 6.** Sensitivity (Sn) and specificity (Sp) for detecting impairment at postinjury time points

	Time of injury		Postgame		Day 1		Day 2		Day 3		Day 5		Day 7	
	Se	Sp	Se	Sp	Se	Sp	Se	Sp	Se	Sp	Se	Sp	Se	Sp
GSC	.89	1.00	.74	1.00	.53	1.00	.27	1.00	.20	1.00	.10	1.00	.04	1.00
BESS	.34	.91	.31	.96	.16	.93	.24	.91	.16	.91	.10	.93	.07	.95
SAC	.80	.91	.65	.93	.31	.95	.22	.89	.18	.93	.18	.93	.02	.98
Brief battery without NP testing	.94	.89	.86	.89	.69	.89	.51	.84	.38	.84	.26	.87	.14	.93
NP testing	—	—	—	—	—	—	.23	.93	—	—	—	—	.19	.91
Full battery with NP testing	—	—	—	—	—	—	.56	.79	—	—	—	—	.30	.86

*Notes.* Sensitivity values indicate the probability that a player originally injured continued to be correctly classified as “abnormal”. Specificity (Sp) refers to the probability that a control participant will be correctly classified as “normal” using the same method.

Brief battery refers to GSC, BESS, and SAC. Full battery refers to brief battery plus neuropsychological testing.

GSC = Graded Symptom Checklist (Lovell & Collins, 1998); BESS = Balance Error Scoring System (Guskiewicz et al., 2001); SAC = Standardized Assessment of Concussion (McCrea et al., 2000); NP testing = neuropsychological test battery

# Comprehensive Assessment

Assessment including all components has best diagnostic utility

– More than doubles the Sensitivity at 7 days post injury

**\*\*Reduces the number of FALSE NEGATIVES\*\***

**Table 6.** Sensitivity (Sn) and specificity (Sp) for detecting impairment at postinjury time points

	Time of injury		Postgame		Day 1		Day 2		Day 3		Day 5		Day 7	
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*Notes.* Sensitivity values indicate the probability that a player originally injured continued to be correctly classified as “abnormal”. Specificity (Sp) refers to the probability that a control participant will be correctly classified as “normal” using the same method.

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# Assessment / Re-assessment

- Acute Concussion Evaluation Care Plan
  - [Clinician Resource](#)
  - [School Resource](#)
  - [Work Resource](#)



Available at:

Centers for Disease Control and Prevention “Head’s Up: Brain Injury in your Practice”

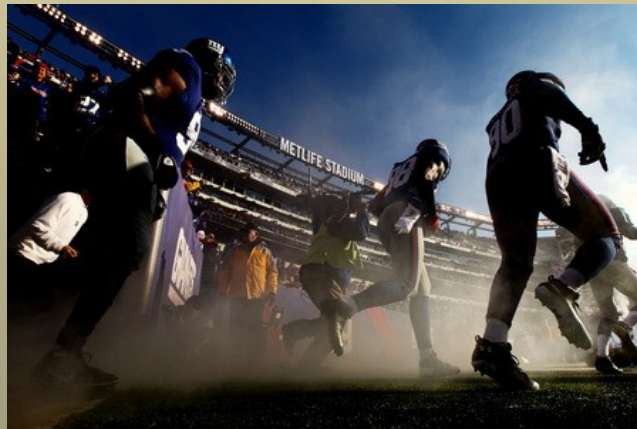
[http://www.cdc.gov/concussion/HeadsUp/physicians\\_tool\\_kit.html](http://www.cdc.gov/concussion/HeadsUp/physicians_tool_kit.html)

# Current Concepts in Sports Concussion: Opportunities for the Physical Therapist

Concussion Management:  
Return to Play

# Concussion Management: Return to Play

- Objectives:
  - Review guidelines / criteria for return to play
  - Identify components and importance of a graduated return to play / program of exertion
  - Identify importance of additional factors that influence the decision-making process



# Return to Play

## Return to Play – Overarching Principles

1. *Symptom Free*
  - a) Negative Neurological tests
  - b) Return to baseline balance scores
  - c) Return to baseline neuropsychological scores
2. *No pharmacologic agents*
3. *No symptoms with provocative / physiologic stress*
4. *Advance through Graduated Return to Play Program*



# Return to Play

## Graduated Return to Play

a.k.a. provocative / physiologic stress

Typical components:

1. Light aerobic exercise
2. Sport-specific exercise
3. Non-contact training drills
4. Full-contact practice
5. Return to play



# Return to Play

## Graduated Return to Play

**Table 1**  
Graduated return to play 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% MPHR. 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, cognitive load
5. Full contact practice	Following medical clearance, participate in normal training activities	Restore confidence, assessment of functional skills by coaching staff
6. Return to play	Normal game play	

HR = heart rate, MPHR = maximum predicted heart rate.

Consensus Statement on Concussion in Sport – the 3<sup>rd</sup> International Conference on Concussion in Sport held in Zurich, November 2008

# UGA – Exertional Testing Protocol

Symptom checklist, Neurocom  
and IMPACT testing WNL

## Exertional Testing Protocol

1. 10 min on stationary bike; exercise intensity <70% maximum predicted heart rate
2. 10 min continuous jogging on treadmill; exercise intensity <70% maximum predicted heart rate
3. Strength training: (i.e. push-ups, sit-ups, squats thrusts)
4. Advanced cardiovascular training: sprint activities
5. Advanced strength training: weight lifting exercises
6. Sport specific agility drills (no risk of contact)

**If no change or increase in symptoms, move to next step.**

Non-contact practice following completion of exertional protocol

**If no change or increase in symptoms, move to next step.**

Limited to full contact practice

**If no change or increase in symptoms, final return to play decision made by medical**

# UNC – Graduated Return to Play

## 5-Step Graduated Exertional Return to Play Protocol

This exertional protocol allows a gradual increase in volume and intensity during the return to play process. The athlete is monitored for any concussion-like signs/symptoms during and after each exertional activity.

The following steps are not ALL to be performed on the same day. In some cases, steps 1, 2, or 3 (or even 4) may be completed on the same day, but typically will occur over multiple days. Steps 4 and 5 will each be performed on separate and subsequent days.

**Exertion Step 1:** 20 minute stationary bike ride (10-14 MPH)

**Exertion Step 2:** Interval bike ride: 30 sec sprint (18-20 MPH/10-14 MPH)/30 sec recovery x 10; and bodyweight circuit: Squats/Push Ups/Situps x 20 sec x 3

**Exertion Step 3:** 60 yard shuttle run x 10 (40 sec rest); and plyometric workout: 10 yard bounding/10 medicine ball throws/10 vertical jumps x 3; and non-contact, sports-specific drills for approximately 15 minutes

**Exertion Step 4:** Limited, controlled return to full-contact practice and monitoring for symptoms

**Exertion Step 5:** Full sport participation in a practice

No athlete can return to full activity or competitions until they are asymptomatic in limited, controlled, and full-contact activities, and cleared by the team physician.

# UCF – Progressive Exertional Test Procedure

## POST-CONCUSSIVE CARE

A student-athlete who sustains a concussion will rest from all cognitive and physical exertion as well as excessive stimulation until their symptoms have cleared for 24 hours.

1. The daily symptom checklist should be completed to assess the student-athlete (See Appendix C). Results should be reviewed with the Team Physician or his/her designee.
2. Once asymptomatic for 24 hours, and an exam with normal is established by the Team Physician or his/her designee, the student-athlete will undergo a progressive exertional test procedure to assess for return of symptoms. There is no set timeline that these exertional tests must follow due to the individual nature of MTBIs. Examples of progressive exertional testing include, but are not limited to, the following:
  - a. Mild to moderate intensity cardiovascular exercise. (ex. Stationary bike or walking for 20 minutes)
  - b. Moderate to high intensity cardiovascular exercise.
  - c. Sub-maximal weight lifting session
  - d. Sport-specific drills; non-contact
  - e. Sport-specific drills; limited contact/reps
3. If the student-athlete remains symptom-free with an exertional challenge, the student-athlete will progress through a series of progressive activities to allow for continued rehabilitation of the concussion for as long as it takes for them to safely return to full participation.
  - a. If the student-athlete's symptoms recur at any point in this progression, one should return to level of activity that produced no symptoms.
4. Post-concussive ImPACT testing should be reserved until the student-athlete is asymptomatic and has a normal exam, unless otherwise directed by a Team Physician.
5. Post-concussive ImPACT testing should ideally be administered no sooner than within 2 days (~48 hours) post-injury to provide for the most accurate test. Avoidance of testing immediately after exertion is recommended.
6. Results of ImPACT testing will be reviewed by the Team Physician and/or his/her designee.
7. If post-concussive ImPACT is abnormal, despite clearance of symptoms and negative exertional testing, further evaluation by the Team Physician may be required.

# Return to Play

Same Day?





# Return to Play: Modifiers

- Decisions not always clear : Neither is information



- Evolution of information
  - Greater / more widespread use of tools
  - Many populations involved
  - Inability to control & appropriately classify concussion severity



# Return to Play: Modifiers

<b>Factors</b>	<b>Modifier</b>
Symptoms	Number Duration (> 10 days) Severity
Signs	Prolonged LOC (> 1min), Amnesia
Sequelae	Concussive convulsions
Temporal	Frequency - repeated concussions over time Timing - injuries close together in time "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

Consensus Statement on Concussion in Sport – the 3<sup>rd</sup> International Conference on Concussion in Sport held in Zurich, November 2008

# Return to Play: Modifiers

- Outcomes differ between High School & College Athletes – AJSM 2012.
  - **Recovery rate & outcomes** as assessed at baseline, 2,7, & 14 days post concussion
  - 296 athletes (age 14-25) post concussion in CA, LA, MI, TN from 2008-2010. Analysis of IMPACT components & BESS
    - HS < College for Verbal & Visual memory
    - Females < Males for Visual memory
    - Females = more symptoms on Symptom Checklist & Greater severity
    - HS Male < College Male for BESS
    - College Female < College Female for BESS
    - HS = longer memory impairments (10-14 days) and some motor processing (21 days)

Covassin, T, Elbin, R, Harris, W, Parker, T, Kontos, A. The Role of Age and Sex in Symptoms, Neurocognitive Performance, and Postural Stability in Athletes After Concussion. American Journal of Sports Medicine. 2012; 40 (6): 1303-1312.

# Concussion Management Resources

- Consensus statement on concussion in sport – The 3rd International Conference on concussion in sport, Held in Zurich, November 2008
- Centers for Disease Control and Prevention
- US National Athletic Trainers' Association (NATA) Position Statement
- American College of Sports Medicine Consensus Statement
- American Academy of Neurology
- US Team Physician Consensus Statement