## Concussion 2013: More Questions Than Answers?

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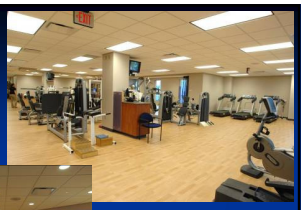
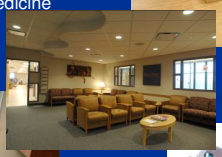



## *For Handouts or References*

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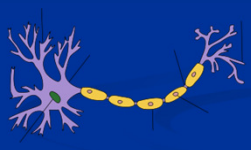
## *Current Position Statements*

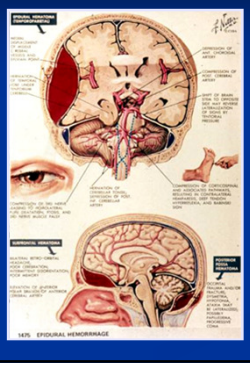
- AMSSM (Jan. 2013)
  - Position Statement for Concussion in Sport
- 4th International Conference on Concussion (held Nov. 2012 in Zurich, published Feb. 2013)
  - Consensus Statement for Concussion in Sport
- American Academy of Neurology
  - Evidence-based Guidelines for the Evaluation and Management of Concussion in Sport (March 2013)
- NATA Guidelines (due later 2013)

## What is a Concussion

- Functional brain injury – MRI/CT Normal - NOT structural
- Metabolic Brain Injury – slowdown of cerebral blood flow chemical "energy crisis" in the brain
- Study of axonal injury
- The brain is a non-renewable resource (Hovda-UCLA)



## What is not a Concussion?



- Closed head injury with structural defect

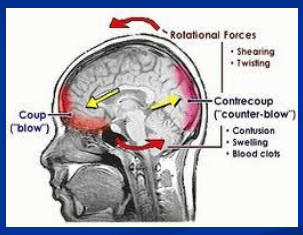
(brain bleed or brain swelling)

  - Epidural
  - Subdural
  - Parenchymal

- MRI/CT Scan usually normal

## Mechanism of Injury

- Linear acceleration
- Angular/Rotational acceleration
  - Measured by G-Forces (accelerometer/gyroscope)



# Mechanism of Injury

## Indirect/Rotational

"a forceful blow to the body that results in rapid movement of the head."

Rapid acceleration / deceleration = WHIPLASH

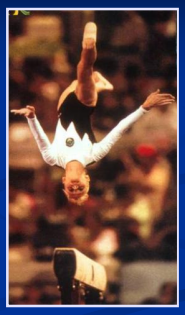
or "SNAP-BACK"

or "JOLT" to the brain

# Who Is At Risk?

## Incidence

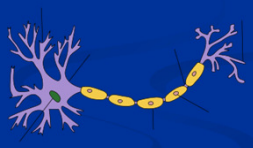
- CDC estimate 3.8 million concussion per year in US sports
- 1997-2007: (Peds 2010)
  - ER visits for sports concussion doubled (8-13 yrs)
  - Increased by greater than 200% (14-19 yrs)
- Recurrence Risk
  - 4-5x increase for 2nd injury
- 85-90% full clinical recovery in 1st two weeks



**What is the cause of the 15%?**

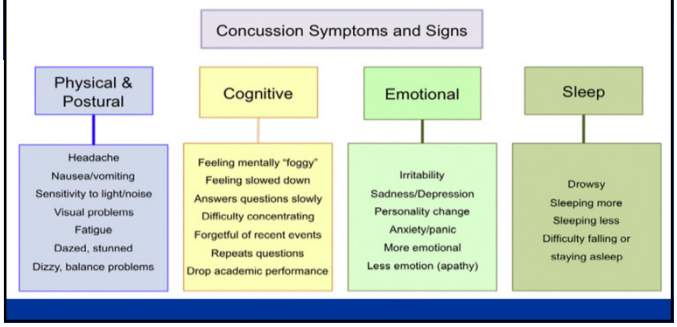
# Why Does it Matter?

## The Brain is a Non-Renewable Resource

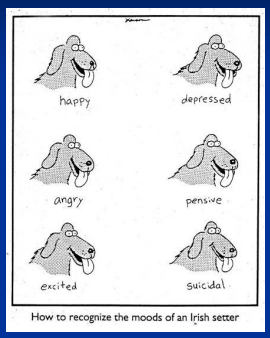


**When does this injury become irreversible/cumulative?**

## *Diagnosis: What is the Clinical Presentation*




## *Symptom Evaluation / Challenges*



How to recognize the moods of an Irish setter

- "Silent Epidemic"
- "Invisible Injury"
- "Subtle but Serious"
- "Energy crisis in the brain"

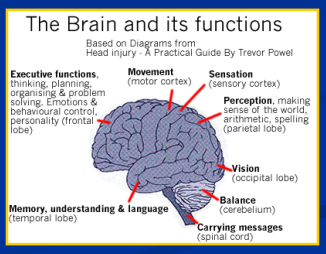
## *Symptom Evaluation/Challenges*

***Traumatic Brain Injury is an Evolving Process NOT a Static Injury***

"If you've seen one concussion you've seen one concussion"
(Herring, Seattle)

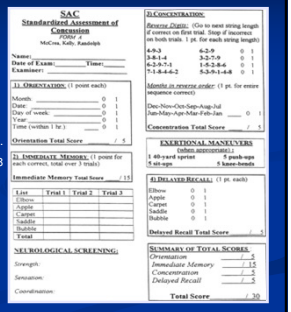
## Where is the injury in the brain?
## *Location*

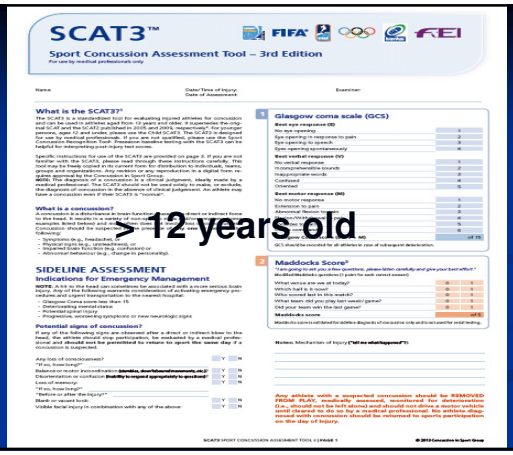
- Back of Head
  - LOC (RAS)
  - Visual (Visual Center)
  - Balance (Cerebellum)
- Temporal
  - Memory Center
- Frontal
  - Repetitive Actions
  - Emotionality



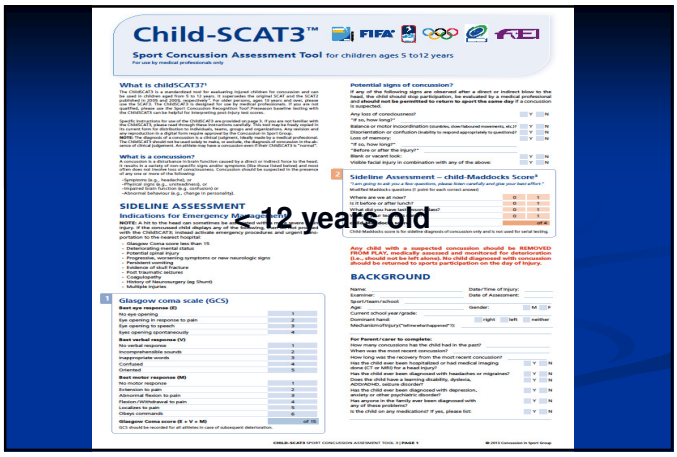

## How Do We Assess on the Sideline?

- McCrea, et al (Duke 2001)
- SAC Exam
- Months of the year in reverse (90%)
- Serial 7's (51%)
  - Young et al, Clin J Sport Med. 1997 Jul;7(3):196-8
- SAC replaced by SCAT Sports Concussion Assessment Tool
  - Added balance testing




**> 12 years old**



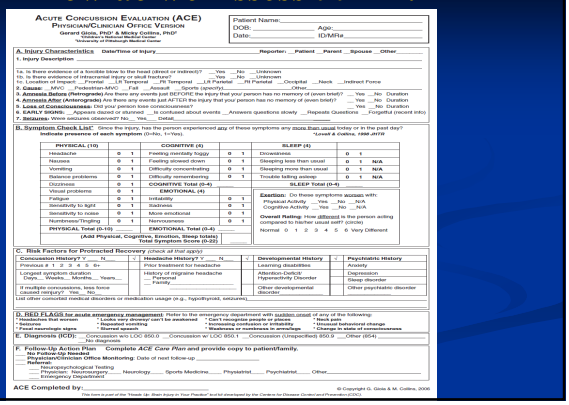
Child-SCAT3™

Sport Concussion Assessment Tool for children ages 5 to12 years

For use by medical professionals only

< 12 years old

# How do we Assess in ER?



ACUTE CONCUSSION EVALUATION (ACE)
PHYSICIAN/CLINICIAN OFFICE VERSION

Gerard Gioia, PhD[a] & Micky Collins, PhD[b]
[a]Children's National Medical Center
[b]University of Pittsburgh Medical Center

# Emergent Evaluation

## *First 24 Hours(cont'd)*

- Double vision/blurred vision/pupils unequal
- Change in consciousness/unarousable
- Numbness, weakness, unequal/asymmetry one extremity or part of body
- Change in breathing pattern
- Seizures
- Make sure athlete is not left alone for 1st 24 hrs.

## *Problems with Initial Diagnosis*
### *University of Akron Study* *(Silent Epidemic)*

- What was a concussion?
  - 461 athletes(pre-season survey 1995 - 2000)
    - only 19% reported concussion
- 80% of concussions missed initially

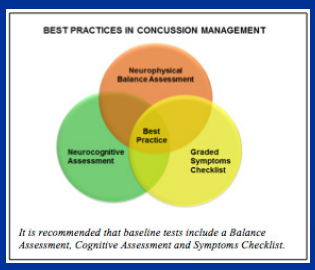
U of A (CJSM) Kaut, DePompei, Kerr, Congeni, 2003

**What is the risk of sub-concussive blows to the brain?**

## *"Monday Morning Concussion"*

- The way the person feels
  - Headache or fatigue
- How they think
  - Memory or concentration
- Change in emotions
  - Irritable or sad
- How they sleep
  - Trouble falling asleep
- "Monday Morning Concussion"

## How Do We Assess In The Office?
### *Not all patients need a full evaluation (RTP/ prolonged recovery)*




- Three legged stool
- > 30% of concussion patients with normal symptom scale had cognitive deficit

## Symptom Scale

### *(helpful, but has limitations)*

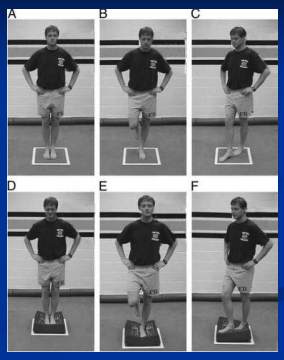
The Post concussion Symptom Scale is essentially a "state" measure of perceived symptoms associated with concussion. That is, the athlete is asked to report his or her "current" experience of the symptoms. This allows tracking of symptoms over very short intervals, such as consecutive days or every few days.

**Directions:** After reading each symptom, please circle the number that best describes the way the athlete has been feeling today. A rating of 0 means they have not experienced this symptom today. A rating of 6 means they have experienced severe problems with this symptom today.

| Date tested | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date of Last known concussion(s) | | | | | | | |
| **SYMPTOM** | **None** | **Mild** | | **Moderate** | | **Severe** | |
| Headache | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Nausea | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Vomiting | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Balance Problems | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Dizziness | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Fatigue | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Trouble Falling Asleep | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Sleeping More Than Usual | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Sleeping Less Than Usual | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Drowsiness | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Sensitivity to Light | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Sensitivity to Noise | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Irritability | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Sadness | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Nervousness | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Feeling More Emotional | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Numbness or Tingling | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Feeling Slowed Down | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Feeling Mentally "Foggy" | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Difficulty Concentrating | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Difficulty Remembering | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Visual Problems (double vision, blurring, etc) | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| TOTAL SYMPTOM SCORE: | | | | | | | |
| GRAND TOTAL OF ALL SYMPTOMS: | | | | | | | |

## *Balance Assessment*

- Head injury and postural stability
- Model postural control (steadiness)
- Firm and foam evaluation




## *Balance Assessment (Cont'd)*

## *BESS (Balance Error Scoring System)*

All tests are performed for 20 second trials with the score equaling the number of errors that occurred; therefore, the higher the score the worse the performance.

| | Number of Errors | |
|---|---|---|
| | *Eyes Open* | *Eyes Closed* |
| 1. Double leg stance on hard surface | _____ | _____ |
| 2. Single leg stance on hard surface | _____ | _____ |
| 3. Tandem stance on hard surface | _____ | _____ |
| 4. Double leg stance on foam | _____ | _____ |
| 5. Single leg stance on foam | _____ | _____ |
| 6. Tandem stance on foam | _____ | _____ |

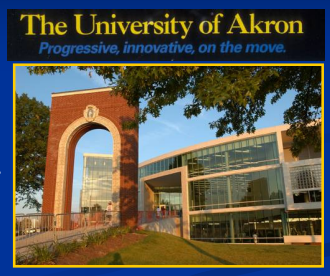
Guskiewicz, 2001, CJSM

## *Vestibular Screening*
### *Middle Ear/Equilibrium Evaluation*

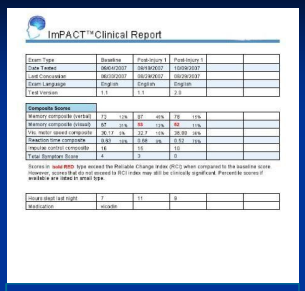
"Vertigo" (15-25%)

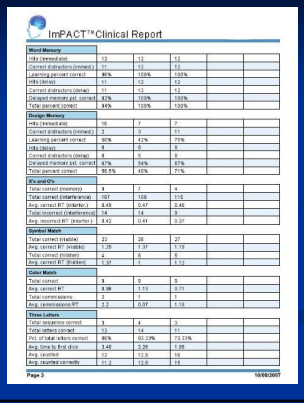
## Neuropsychological/Cognitive Testing

- Manual testing (PSU/UA 1992-93)
- Computerized testing (2002)
- ImPACT/Axon/Headminder




## *ImPACT*


ImPACT™Clinical Report


ImPACT™Clinical Report

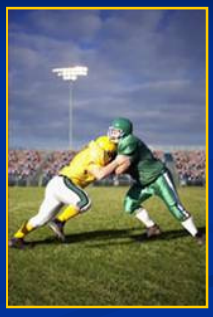
1. Visual Memory
2. Verbal Memory
3. Problem Solving
4. Reaction Time

## *Exertional Testing*

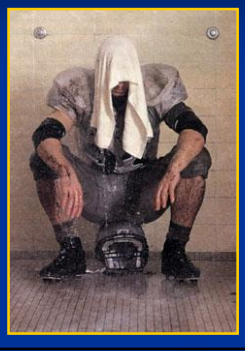
- Bike, treadmill, step test
- Can be done in the physician's office or at school under the direction of the Athletic Trainer.

## When to Return to Play? (100%?)

- Asymptomatic at rest
- Asymptomatic with exertion
- Normal neurocognitive test
- Normal subjective scale (<7)
- Normal neurological and cervical exams, as well normal balance testing.



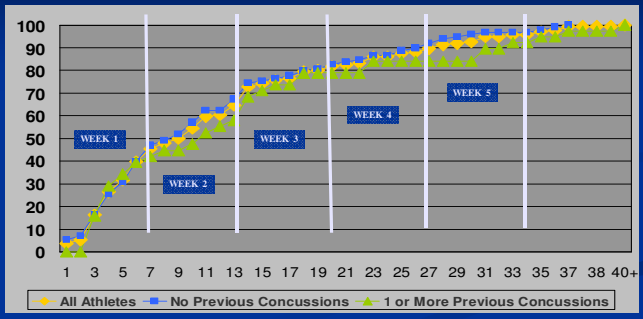
## When to Retire?



Consider:

- Increased length of symptoms
- Decreased trauma induces concussions
- Decreased time between concussions

## *Recovery From Concussion:*
How Long Does it Take?




N=134 High School athletes

Collins et al., 2006, Neurosurgery

## *Examining Risk Factors for Prolonged Recovery Following Sports Concussion*

- Age
  - Field, Lovell, Collins et al. J of Pediatrics 2003
  - (Pellman, Lovell et al. Neurosurgery 2006
  - Guskiewicz. 2011 Pm R
- Previous concussion
  - Collins, Lovell et al, Neurosurgery 2004
  - Iverson, Lovell, Collins, Brit J Sport Med, 2006
  - Hollis. 2009 Am J of SM
- Migraine History
  - Lipton. JAMA 2004
- Genetics
  - APOE e4: Tierney. Clin J Sport Med 2010
- Gender Differences
  - Females have higher rate of concussion 1:7:1
  - Females more prone to post-concussion symptoms
  - Neck strength differences?
  - Lovell. Clin Sports Med 28 (2009) 95-11
- Mood Disorders
  - Kontos. Arch Phys Med Rehab 2012

**Is depression, anxiety, irritability pre, post, or part of the biochemical brain injury?**

## *Can We Treat Concussion?*
### *Management*


"Yo, Dewey! Got another one over here when you're done."

Physical Rest
&
Mental Rest

## *Mental Rest (Brain Rest) School and Activity Modifications*

- Students held from school
- Full day/partial day/rest periods
- Driving may be restricted
- Workload/homework reduced
- Tests restricted/postponed (esp SAT, PSAT, finals)

## *Mental Rest ("Brain Rest") (cont'd)*

- Avoid loud activities (parties, dances, concerts, sports events) or (I-pods, headphones)
- Avoid bright sunlight (sunglasses, shade) and computer games
- Avoid spinning carnival rides.
- Avoid alcohol/drugs
- "Return to Learn"

These modifications seem to hasten recovery

- Moser RS, et al., *J Pediatrics* 2012

**How long?**

## *Physical Rest*

Return To Play

Physical rest until asymptomatic

| | |
|---|---|
| Stage I | Light aerobic training (no resistance) |
| Stage II | Sport specific training (can start resistance) |
| Stage III | Non-contact training drills |
| Stage IV | Full contact after physician clearance |
| Stage V | Competition |

McCrory et al, Clin J of Sp Med (2005)

**Early Rehab? Cervical Rehab?**

## Can We Prevent Head Injuries?

- Neck/trunk strengthening
- Helmets for biking, snow sports, and inline skating
- Teach head injury signs/symptoms and management principals to coaches, trainers and physicians (before season!)

## *Prevention – Pretest*

- Baseline – ImPACT/Axon
- Ideal time is at the PPE
- Baseline Balance Testing?

## *Prevention - Soccer*

- Prevent rough play especially with goalie
- Avoid backwards "head flick"
- Avoid heading with arms above head
- Padded goal post
- Head gear?

## *Prevention - Football*

- Properly fitted helmet
- Neck-trunk strengthening
- Technique = proper blocking, tackling
- Tough enforcement of no head to head contact
- Limit number of contact practices
- Proper "Heads Up" tackling technique most effective (2013 AAP)

## *Prevention – Youth Changes Coaches / Parent's Role*

- "BRAINSAVERS"
  - Be aware of subtle changes in behavior
- HELP CHANGE CULTURE
  - Can't tough out head injuries
  - Difference between pain & injury
  - No dings, bell ringers, seeing stars
- NO BLINDSIDE HIT DRILLS
  - Learn to take and deliver a blow
- NEW GUIDELINES – Pop Warner rules 2012
- Can we change the "Culture of Tough" when it comes to head injuries?

## *Prevention–Legislation*

- Washington State – Return to play law
  - Zachery Lystedt's Law (2009)
    1. No return to contact sport following concussion without medical clearance
    2. 5 stage gradual return after clearance
    3. Mandatory education for coaches/players

## *What's New – 2011*
### *Is concussion only a "Football" problem?*

- Fastest growing HS sport
1. Girls Basketball
2. Girls Soccer

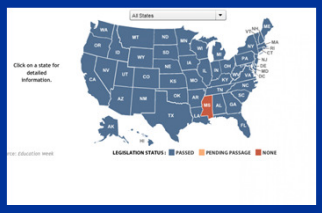
- Top 5 Sports:
1. Football
2. Ice Hockey
3. Soccer
4. Lacrosse
5. Wrestling


## *Prevention – Hockey/Lacrosse*

- Eliminate blind sided hits
- No body checking until age 13 (Bantam level)


## *What's new – 2012*
### *Ohio House Bill 143*

- 49 states with concussion legislation (9/1/2013)
- Ohio law implementation 4/26/2013




## *Long Term Complications*

- Learning disability/cognitive deterioration (Neurosurg 2005)
- Concentration issues
  - Short term meds – ADHD
    - (Arch Phys Med Rehabil. 2003)
- Depression
  - Psychotherapy, antidepressants
  - 3 time increase (Medicine Science and Sports Exchange 2007)
- Chronic headache – (Pain Med. 2008)
- Permanent brain damage (ESPN – Outside The Lines 2007)
  - (CTE / Lou Gehrig's ALS, 2ND Impact Syndrome)

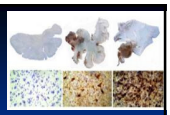
## *University of Michigan Study 2009*
## *"NFL Study" -Rates of Dementia*

| Reported Rates | US Men Age 30-49 | US Men Age 50+ | NFL Retirees Age 40-49 | NFL Retirees Age 50+ |
|---|---|---|---|---|
| Dementia, Alzheimer's (%) | 0.1 | 1.2 | 1.9 | 6.1 |

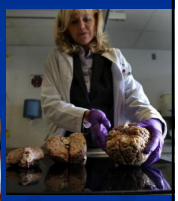

408% increase in NFL Retirees age 50+

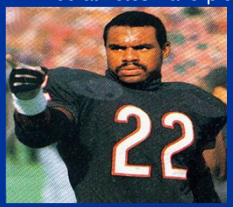
$760 million settlement – summer 2013

## *"Brain Collectors"*



- Boston University School of Medicine, Center for the Study of Traumatic Encephalopathy
  - 46 deceased athletes
    - 90% had Chronic Traumatic Encephalopathy
  - >400 athletes have pledged their brains (Feb 2012)

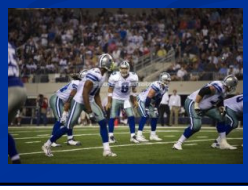




Dr. Ann McKee

## What's New – 2010-2014
### NFL Rules Changes

- More strict helmet to helmet rules (2010-2013)
- New kickoff rules (2012)
- Targeting with crown of helmet (2013)
- Strike Zone (2013)
- Penalty box?



## What's New – 2010-2014
### Equipment

- The Helmet that can Save Football (Popular Science Jan. 2013)
  - Change in testing headgear from linear to rotational impact
  - Riddell 360
    - (negligence suit $11.5 million award April 15, 2013)
  - Guardian Cap, many others
  - Stockholm, Sweden – MIPS Helmet (Multi-directional Impact Protection System)

## What's New 2012-2014
### Virtual Reality Sideline Tools cont.

- BrainScope
- X2 Impact Mouthpiece

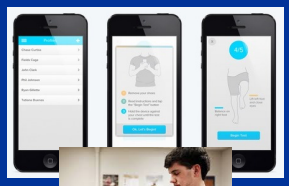
**Is there an objective test to help us diagnose?**

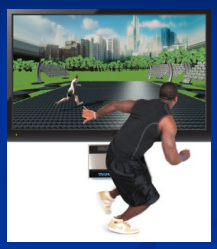
## What's New – 2013
### Sideline Tools

- Sensors
  - Riddell
  - Reebok
  - Shockbox


## What's New – 2013
### Virtual Reality Balance Assessment

- Trazer
- Sway Balance





## Myths

- Must have LOC to be a concussion (10-20%)
- Normal MRI/CT – R/O concussion (R/O bleed)
- Concussion are all brief, transient, no complications (see complications….)
- No treatment (physical and mental rest)

# *Bottom Line Discussions*

**Over-Reacting**

- **Compare with MVA/ Teenage Drinking**

**Knee-Jerk Reaction**

**a.) "one and done" (single concussion-out for sports season**
**b.) eliminate youth football (flag)**
**c.) eliminate all American Football**

- Prevention

Prevent occurrence → Improve Timely Recognition (Initial Management) → Neuro/Cognitive Rehab Significant Brain Injury

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