NATIONWIDE CHILDREN'S
When your child needs a hospital, everything matters.℠

Pediatric Concussion Management: Sideline to ED to Clinic

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First: A quiz!

A concussion is a traumatic brain injury.

WHEN IN DOUBT, SIT THEM OUT!

Definition:

- "Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces."
  - *McCory et al* **Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012** *Br J Sports Med* 2013

Classification of Concussion

- No consensus
- Previously: Simple vs. Complex
- We (Concussion specialists) don't "grade" concussions anymore (AAN, 1997 and 2013)
- 80-90% of concussions resolve in a short period (1-10 days or less). This recovery time may be longer in children & adolescents

Classification:

- There have been more than 20 classification systems and guidelines published since 1977
- Here are a few:

Classification:

- Cantu
- Ommaya and Gennarelli
- Colorado
- 1997 American Academy of Neurology
  - None of these classification systems were created to classify children
  - Some studies have suggested that LOC may not be an adequate predictor of short-term or long-term neurologic functioning, which made classification more controversial

Classification of Concussion

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Concussion: Why should we care?

- 30 million children and adolescents participate in sports in the US each year
- "Silent" epidemic
  - Up to 3.8 million sports-related concussions each yr
  - LOC (<10%)
- Over half go unreported
- Girls > Boys (D Comstock, CIRP/NCH Research Institute)
- Catastrophic FB head injuries are 3x more likely to occur in HS than college athletes

TABLE 1 Concussion Rates in High School Sports

Sport	Injury Rate, per 1000 Athlete Exposures
Football	0.47–1.03[a,b]
Girls' soccer	0.36[a]
Boys' lacrosse	0.28–0.34[c,d]
Boys' soccer	0.22[a]
Girls' basketball	0.21[a]
Wrestling	0.18[a]
Girls' lacrosse	0.10–0.21[c,d]
Softball	0.07[a]
Boys' basketball	0.07[a]
Boys' and girls' volleyball	0.05[a]
Baseball	0.05[a]

[a] Data from Gessel LM, Fields SK, Collins CL, Dick RW, Comstock RD. Concussions among United States high school and collegiate athletes. *J Athl Train*. 2007;42(4):495–503.
[b] Data from Guskiewicz KM, Weaver NL, Padua DA, Garrett WE. Epidemiology of concussion in collegiate and high school football players. *Am J Sports Med*. 2000;28(5):643–650.
[c] Data from Lincoln AE, Hinton RY, Almquist JL, Head, face, and eye injuries in scholastic and collegiate lacrosse: a 4-year prospective study. *Am J Sports Med*. 2007;35(2):207–215.
[d] Data from Hinton RY, Lincoln AE, Almquist JL. Epidemiology of lacrosse injuries in high school-aged girls and boys: a 3-year prospective study. *Am J Sports Med*. 2005;33(9):1305–1314.

Halstead & Walter. *Pediatrics*, 2010.

CONCUSSIONS ARE UNDER-REPORTED IN HS ATHLETES

(McCrea M, et al. *Clin J Sport Med*, 2004)

- Only 47% of high school athletes reported their concussion
- Most common reasons for not reporting:
- Not serious enough to warrant medical attention (66%)
- Didn't want to be withheld from play (41%)
- Lack of awareness of probable concussion (36%)
- Didn't want to let teammates down (22%)

"The Hidden Epidemic"

- The true incidence is unknown.
  - Estimated that up to 50% of concussions receive no medical treatment. This may be even higher in the pediatric population-especially athletes.
  - There is no good evidence on incidence in pre-high school age group
  - Best data is inaccurate due to inconsistent terminology and coding

Incidence:

- AHA Data 2004:
  - 475,000 Children 0-14 years old treated for TBI
  - >90% were treated and released from the ED
- Langburt et al. 2001 reported an incidence of 47.2% ($p<.001$) in a survey of football players in Pennsylvania and OHIO
- 1977 survey of high school football players in Minnesota found 19% of players reported at least one concussion during the preceding season

Incidence:

- For high school athletes
  - Football and ice hockey have highest incidence
  - Soccer, wrestling, basketball, field hockey, baseball, softball, and volleyball also have high incidence
  - In certain sports (eg, football, baseball), the risk of injury depends on the position played
  - Higher rates of concussion are seen in games than practices, excepting possibly volleyball and cheerleading
  - Solid concussion incidence data do not yet exist for pre–high school populations

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DOI: 10.1007/s10439-013-0807-6

Head Impact Exposure in Youth Football: Elementary School Ages 9–12 Years and the Effect of Practice Structure

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Associate Editor Peter E. McHugh oversaw the review of this article.

Cobb Et Al. 2013

* Qbjective: to quantify the head impact exposure of youth football players, age 9–12, for all practices and games over the course of single season (2011).

Cobb Et Al. 2013

* A total of 50 players (age = 11.0 ± 1.1 years) on three teams were equipped with helmet mounted accelerometer arrays (H.I.T. system), which monitored each impact players sustained during practices and games.
* During the season, 11,978 impacts were recorded for this age group. Players averaged 240 ± 147 impacts for the season

Cobb Et Al. 2013

* Overall, practice and game sessions involved similar impact frequencies and magnitudes.
* While the acceleration magnitudes among 9–12 year old players tended to be lower than those reported for older players, some recorded high magnitude impacts were similar to those seen at the high school and college level.

Cobb Et Al. 2013

* One of the three teams however, had substantially fewer impacts per practice and lower 95th percentile magnitudes in practices due to a concerted effort to limit contact in practices.
* The same team also participated in fewer practices, further reducing the number of impacts each player experienced in practice.
* Head impact exposures in games showed no statistical difference between teams.

Pop Warner Football

- Rules Changes for 2012 Season
  - contact will not be allowed for two-thirds of each practice
    - 9 hours total practice time each week so can have full contact 3 hours
  - no drills that involve full-speed, head-on blocking and tackling that begins with players lined up more than three yards apart
  - No intentional head to head contact

Incidence:

Children under 5 sustain relatively few TBIs from participating in sports and recreation

Incidence:

- Children vs. Adults
  - The number of TBIs increases as age increases and peaks between the ages of 15 and 24
  - Sports and recreation accounted for:
    - 0.8 injuries per 100,000 persons in children under 5
    - 5.1 per 100,000 in youth 5-14
    - 6.6 per 100,000 in youth aged 15-24
    - After age 24 the number of sports related injuries drops precipitously as age increases

Incidence:

Males vs. Females

- Data demonstrates a higher incidence for women than men in sports where the rules are the same for both genders
  - Soccer, basketball and ice hockey
- Several studies in 2009-10, concluded that female soccer players performed worse than males on post-concussive neurocognitive testing
- Women also were shown to report more post-concussive symptoms
- The explanation of this trend is unknown and may include biomechanical, hormonal, and cultural factors

Incidence:

Males vs. Females

NCAA Game Related Concussion Rates by Gender Across similar sports 2008-2010

	Rate	Games/Concussion
Soccer (W)	1.8	28
Soccer (M)	1.4	36
Basketball (W)	0.9	111
Basketball (M)	0.4	250

Sideline Management

Sideline Management

- Management guidelines that have been published are not truly evidence based as there are conspicuously few research studies that have been published that focus specifically on concussion management in the pediatric population.
- The American Academy of Pediatrics has published a practice parameter for the general management of minor closed head injury in children
- AAP also endorsed the sport-specific, but not child-specific, guidelines generated by the American Orthopedic Society for Sports Medicine Concussion Workshop Group

Guidelines

- Zurich 2012 (Consensu Statement on Concussion in Sport) March 2013
- American Academy of Neurology guidelines March 2013
- American Academy of Family Physicians, the American Academy of Orthopaedic Surgeons, the American College of Sports Medicine, the American Medical Society for Sports Medicine, the American Orthopaedic Society for Sports Medicine, and the American Osteopathic Academy of Sports Medicine, Consensus Statement 2011

Guidelines

- All of these guidelines use the same, flawed data as their basis for recommendations.
- Much of this data does not reach above the level of expert opinion.

Sideline Management

- Remove from play
- Proper neck immobilization if indicated
- Neck and Neuro exam
  - Spurling's or other axial load test
  - CN, balance, motor and sensory exam
  - SAC / SCAT2 / BESS or other postural testing
- Orientation / Maddock's Questions
- Once a concussion has been diagnosed = done for the day.
- Beware of the "lucid interval"

"When in Doubt, Sit 'em Out!"

Sideline Management

- Take their helmet
- Apprise the coaches
- A more in-depth
- evaluation to be done in a quiet, private place where you can also speak with parents (e.g: School Training room)
- Serial Exams
- Arrange for follow up

4 **Sideline Assessment – Maddocks Score**

"I am going to ask you a few questions, please listen carefully and give your best effort."

Modified Maddocks questions (1 point for each correct answer)

At what venue are we at today?	0	1
Which half is it now?	0	1
Who scored last in this match?	0	1
What team did you play last week/game?	0	1
Did your team win the last game?	0	1

Maddocks score of 5

Maddocks score is validated for sideline diagnosis of concussion only and is not included in SCAT 2 summary score for serial testing.

Symptom Evaluation

How do you feel?

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

	none	mild	moderate	severe
Headache	0	1	2	3 4 5 6
"Pressure in head"	0	1	2	3 4 5 6
Neck Pain	0	1	2	3 4 5 6
Nausea or vomiting	0	1	2	3 4 5 6
Dizziness	0	1	2	3 4 5 6
Blurred vision	0	1	2	3 4 5 6
Balance problems	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
Feeling slowed down	0	1	2	3 4 5 6
Feeling like "in a fog"	0	1	2	3 4 5 6
"Don't feel right"	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
Fatigue or low energy	0	1	2	3 4 5 6
Confusion	0	1	2	3 4 5 6
Drowsiness	0	1	2	3 4 5 6
Trouble falling asleep (if applicable)	0	1	2	3 4 5 6
More emotional	0	1	2	3 4 5 6
Irritability	0	1	2	3 4 5 6
Sadness	0	1	2	3 4 5 6
Nervous or Anxious	0	1	2	3 4 5 6

Total number of symptoms (Maximum possible 22)

Symptom severity score

5 **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 of 5

Immediate memory

"I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order."

Trials 2 & 3

"I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before."

Complete all 3 trials regardless of score on trial 1 & 2. Read the words at a rate of one per second. Score 1 pt. for each correct response. Total score equals sum across all 3 trials. Do not inform the athlete that delayed recall will be tested.

	Trial 1	Trial 2	Trial 3	Alternative word list
elbow	0 1	0 1	0 1	candle baby finger
apple	0 1	0 1	0 1	paper monkey penny
carpet	0 1	0 1	0 1	sugar perfume blanket
saddle	0 1	0 1	0 1	sandwich sunset lemon
bubble	0 1	0 1	0 1	wagon iron insect
Total				

Immediate memory score of 15

Concentration

Digits Backward

"I am going to read you a string of numbers and when I am done, you repeat them back to me backwards, in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7."

If correct, go to next string length. If incorrect, read trial 2. One point possible for each string length. Stop after incorrect on both trials. The digits should be read at the rate of one per second.

Alternative digit lists

4-9-3	0 1	6-2-9	5-2-6	4-1-5
3-8-1-4	0 1	3-2-7-9	1-7-9-5	4-9-6-8
6-2-9-7-1	0 1	1-5-2-8-6	3-8-5-2-7	6-1-8-4-3
7-1-8-4-6-2	0 1	5-3-9-1-4-8	8-3-1-9-6-4	7-2-4-8-5-6

Months in Reverse Order:

"Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say December, November ... Go ahead"

1 pt. for entire sequence correct

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

Concentration score of 5

S A C

Post-Game Mgmt

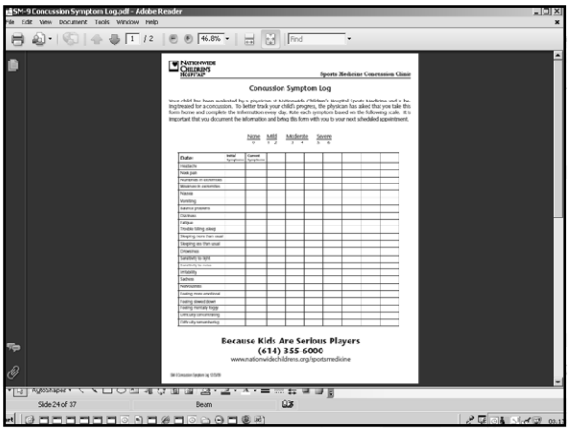
- Precautions / Instructions to family
- Daily symptom log
- Observation by family or trusted individual for 1-2 hrs post injury
- Red flag s/s:
  - Change in mental status (especially decreased Level of consciousness)
  - Worsening headaches' s
  - Intractable vomiting
  - Worsening neck pain
  - Clear fluid from nose or ears
  - Bruising around the eyes or behind the ears
- FU with trainer next am. FU with physician within the next few days
- Physical and cognitive rest (may mean not coming to practice for a few days)

TABLE 2 Signs and Symptoms of a Concussion

Physical	Cognitive	Emotional	Sleep
Headache	Feeling mentally "foggy"	Irritability	Drowsiness
Nausea	Feeling slowed down	Sadness	Sleeping more than usual
Vomiting	Difficulty concentrating	More emotional	Sleeping less than usual
Balance problems	Difficulty remembering	Nervousness	Difficulty falling asleep
Visual problems	Forgetful of recent information		
Fatigue	Confused about recent events		
Sensitivity to light	Answers questions slowly		
Sensitivity to noise	Repeats questions		
Dazed			
Stunned			

Halstead & Walter. *Pediatrics*, 2010

- Symptoms are evolving
- Symptoms are unique to the individual and event
- "When you've seen one concussion, you've seen one"



Executive Summary of Concussion Guidelines Step 1: Systematic Review of Prevalent Indicators
Carney, N et al. Neurosurgery Vol. 75 No. 75, 2014

- First in a series of reports that will be generated by a working group that are intended to build an evidence base for concussion management.
- Review of 5592 abstracts with 1362 full text articles reviewed. 231 met criteria for inclusion.

Executive Summary of Concussion Guidelines Step 1: Systematic Review of Prevalent Indicators
Carney, N et al. Neurosurgery Vol. 75 No. 75, 2014

- 4 key indicators of Concussion in alert individuals (GCS 13-15) were identified:
  - Slower reaction time (reaction time: the interval of time between application of a stimulus and detection of a response) within 2 days after injury, and
  - Impaired verbal learning and memory (verbal learning and memory: the acquisition, retention, and retrieval of verbal material; memory of words and other abstractions involving language) within 2 days after injury.

To Scan, or not to Scan, that is the question.

To Scan or not to Scan

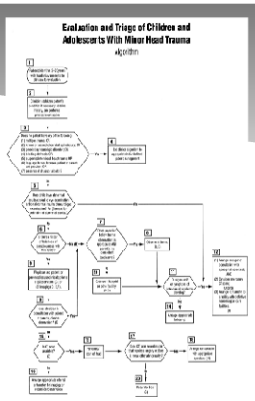
- **Pediatric head injuries: Can clinical factors reliably predict an abnormality on computed tomography?**
  Ann M Dietrich, Mary Jo Bowman, Margaret E Ginn-Pease, Edward Kosnik and Denis R King
  Annals of Emergency MedicineVolume 22, Issue 10, October 1993, Pages 1535-1540
  -Prospective cohort of 324 head CTs performed on 322 consecutive trauma patients
  -LOC, amnesia, GCS<15, and neurologic deficits were more common in children with CT findings.
  -of 195 children with GCS of 15, 11 (5%) had evidence of pathology on CT

To Scan or not to Scan

- 1999 AAP practice parameter
  - A previously neurologically healthy child
  - Ages 2-20 yrs
  - Isolated minor closed head injury
- Defines minor head injury with:
  - Normal mental status at time of exam
  - Normal physical exam (including funduscopic exam)
  - No evidence of skull fracture (hemotympanum, Battle's sign, or palpable bone depression)

To Scan or not to Scan

- Also addresses children with:
  - Temporary loss of consciousness (< 1 min
  - Seizure immediately after injury
  - Vomiting after injury
  - Headache or lethargy after injury
  - Normal at time of evaluation
- NOT intended for:
  - Multiple traumas
  - Unobserved LOC
  - Suspected cervical spine injury
  - Pt with bleeding diatheses
  - Neurologic disorder
  - suspected intentional head trauma



TO SCAN OR NOT TO SCAN

PECARN

PEDIATRIC EMERGENCY CARE APPLIED RESEARCH NETWORK

The first federally-funded pediatric emergency medicine research network in the United States.

PECARN includes six Research Node Centers (RNCs) that work collaboratively with Hospital Emergency Department Affiliates (HEDAs) to develop and conduct nodal research projects.

Great Lakes Emergency Medical Services for Children Research Network (GLEMSCRN)
University of Michigan, AnnArbor
Children's Hospital of Michigan, Detroit
Nationwide Children's Hospital, Columbus


Articles

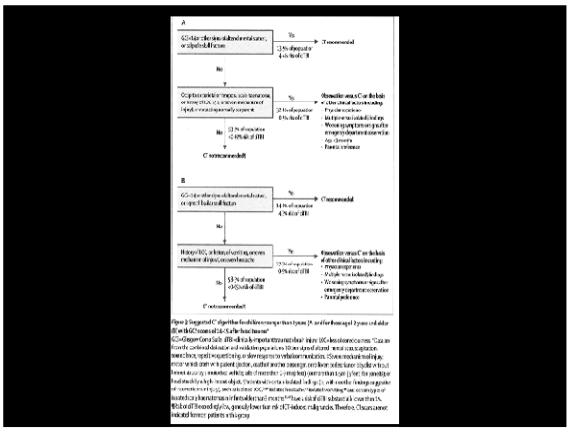
Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study

PECARN Guidelines

- Subjects:
  - 42,412 children <18 years, presenting within 24 hours of trauma, GCS 14-15
  - 25 EDs in North America
- Derivation population (June 2004-March 2006; 10,718 subjects) followed by validation population (March-September 2006; 31,694 subjects)

PECARN Guidelines

- 14,969 CT scans (35.3%)
- 376 Clinically important TBIs(ciTBI) (0.9%)
- 60 Subjects required Neurosurgical procedures (0.1%)
- Two separate algorithms for children older or younger than 2 years



PECARN Guidelines

- The prediction rule for Children under 2 years:
  - Had a negative predictive value for ciTBI of 1176/1176 (100%; 95%CI 99.7-100.0)
  - Had a sensitivity of 25/25 (100%; 95%CI 86.3-100.0)
  - 167 of 694 subjects < 2 who had CT scans were in the low risk group

PECARN Guidelines

- The prediction rule for Children over 2 years:
  - Had a negative predictive value for ciTBI of 3798/3800 (99.95%; 95%CI 99.81-99.99)
  - Had a sensitivity of 61/63 (96.8%; 95%CI 89.0-99.6)
  - 446 of 2223 subjects > 2 who had CT scans were in the low risk group

- Comparison of PECARN, CATCH, and CHALICE rules for children with minor head injury: a prospective cohort study.
- Easter JS; Bakes K; Dhaliwal J; Miller M; Caruso E; Haukoos JS
- Ann Emerg Med. 2014; 64(2):145-52, 152.e1-5 (ISSN: 1097-6760)
- Prospective cohort study of 1,009 Children with minor head injury (GCS 13 to 15)
- Compared three clinical decision rules (Canadian Assessment of Tomography for Childhood Head Injury [CATCH], Children's Head Injury Algorithm for the Prediction of Important Clinical Events [CHALICE], and Pediatric Emergency Care Applied Research Network [PECARN]) and 2 measures of physician judgment (estimated of <1% risk of traumatic brain injury and actual computed tomography ordering practice) to predict clinically important traumatic brain injury

* Comparison of PECARN, CATCH, and CHALICE rules for children with minor head injury: a prospective cohort study.
* Easter JS; Bakes K; Dhaliwal J; Miller M; Caruso E; Haukoos JS
* Ann Emerg Med. 2014; 64(2):145-52, 152.e1-5 (ISSN: 1097-6760)
* clinically important traumatic brain injury was defined as death from traumatic brain injury, need for neurosurgery, intubation greater than 24 hours for traumatic brain injury, or hospital admission greater than 2 nights for traumatic brain injury.
* 21 children (2%; 95% confidence interval [CI] 1% to 3%) had clinically important traumatic brain injuries

* Comparison of PECARN, CATCH, and CHALICE rules for children with minor head injury: a prospective cohort study.
* Easter JS; Bakes K; Dhaliwal J; Miller M; Caruso E; Haukoos JS
* Ann Emerg Med. 2014; 64(2):145-52, 152.e1-5 (ISSN: 1097-6760)
* Only physician practice and PECARN identified all clinically important traumatic brain injuries
* Sensitivities: physician practice and PECARN each 100% (95% CI 84% to 100%), physician estimates 95% (95% CI 76% to 100%), CATCH 91% (95% CI 70% to 99%), and CHALICE 84% (95% CI 60% to 97%)
* Specificities: CHALICE 85% (95% CI 82% to 87%), physician estimates 68% (95% CI 65% to 71%), PECARN 62% (95% CI 59% to 66%), physician practice 50% (95% CI 47% to 53%), and CATCH 44% (95% CI 41% to 47%)

* Comparison of PECARN, CATCH, and CHALICE rules for children with minor head injury: a prospective cohort study.
* Easter JS; Bakes K; Dhaliwal J; Miller M; Caruso E; Haukoos JS
* Ann Emerg Med. 2014; 64(2):145-52, 152.e1-5 (ISSN: 1097-6760)
* Conclusion: Of the 5 modalities studied, only physician practice and PECARN identified all clinically important traumatic brain injuries, with PECARN being slightly more specific.

To Scan or not to Scan

* Do Children With Blunt Head Trauma and Normal CranialComputed Tomography Scan Results Require Hospitalization forNeurologic Observation?
  * James F. Holmes, MD, MPH, Dominic A. Borgialli, DO, MPH, Frances M. Nadel, MD, MSCE, Kimberly S. Quayle, MD, Neil Schambam, MD, Art Cooper, MD, Jeff E. Schunk, MD, Michelle L. Miskin, MS, Shireen M. Atabaki, MD, MPH, John D. Hoyle, MD, Peter S. Dayan, MD, MSc, Nathan Kuppermann, MD, MPH, and the TBI Study Group for the Pediatric Emergency Care Applied Research Network. Annals of Emergency Medicine. Volume xx, No. x, 2011
* Children with blunt head trauma and initial ED GCS scores of 14 or 15 and normal cranial CT scan results are at very low risk for subsequent traumatic findings on neuroimaging and extremely low risk of needing neurosurgical intervention. Hospitalization of children with minor head trauma after normal CT scan results for neurologic observation is generally unnecessary

To Scan or not to Scan

* **The Effect of Observation on Cranial Computed Tomography Utilization for Children After Blunt Head Trauma**
  * Lise E. Nigrovic, Jeff E. Schunk, Adele Foerster, Arthur Cooper, Michelle Miskin,Shireen M. Atabaki, John Hoyle, Peter S. Dayan, James F. Holmes, Nathan Kuppermann and the Traumatic Brain Injury Group for the Pediatric Emergency Care Applied Research Network: *Pediatrics 2011;127;1067*
* Clinical observation was associated with reduced computed tomography use (31.1% vs 35%) among children with minor blunt head trauma and may be an effective strategy to reduce computed tomography use

To Scan or not to Scan

* MRI
  * In the absence of neurologic deficits, there is no indication for MRI after concussion.
  * MRI may show DAI but this is rare and is not unlikely to alter treatment.

To Scan or not to Scan

- Newer imaging techniques fMRI, PET scan, and Quantitative EEG may show differences after concussion.
- However, these have not been shown to correlate to cognitive function or risk of additional injury
- There is almost no pediatric data.
- These remain investigational.

Office Management:

- Cognitive assessment
  - For both pediatric and adult populations, conventional neuropsychological assessment is a well-established
  - However, the general use of comprehensive neuropsychological evaluations is impractical, because traditional testing takes multiple hours to complete and is priced accordingly.
  - Beginning in the 1980s, a model of abbreviated "baseline" neuropsychological testing was introduced specifically for athletic purposes.

Office Management:

- Cognitive assessment
  - baseline neuro-cognitive testing lasting approximately 30 minutes
  - Post-injury comparison testing for athletes who sustain concussions during the season
  - baseline battery originally consisted of paper-and-pencil instruments
  - computerized tests have been increasingly used, because they are thought to have a number of potential advantages over paper-and-pencil measures.

Office Management:

- Cognitive assessment
  - Three computerized programs are now available commercially:
  - the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT Applica- tions, Inc, Pittsburgh, PA)
  - Concussion Resolution Index (I1eadminder, Inc, New York, NY),
  - Axon (formerally, CogSport or Cogstate-Sport) (Cogstate Ltd, Victoria, Australia)

Office Management:

- Cognitive assessment
  - The Automated Neuropsychological Assessment Metrics is a computerized program available free of charge through work sponsored by the US government (Department of Defense)

Office Management:

- Cognitive assessment
  - In theory, baseline neuropsychological testing could provide incremental information to assist in decisions about return to play
  - Cognitive and somatic problems are not perfectly correlated after concussion
  - Standardized testing may be more objective than merely asking an athlete if he or she is still experiencing cognitive problems

Detecting cognitive impairment after concussion: sensitivity of change from baseline and normative data methods using the CogSport/Axon cognitive test battery.

Louey AG; Cromer JA; Schembri AJ; Darby DG; Maruff P; Makdissi M; Mccrory P

/Title

Arch Clin Neuropsychol. 2014; 29(5):432-41

* The study aimed to compare the sensitivity and specificity of these two methods using the CogSport/Axon test battery
* Normative data and reliable change indices were computed from a non-injured athlete sample (n = 235)
* Test-retest data from non-injured (n = 260) and recently concussed (n = 29) athlete samples were then used to compare the two methods

Detecting cognitive impairment after concussion: sensitivity of change from baseline and normative data methods using the CogSport/Axon cognitive test battery.

Louey AG; Cromer JA; Schembri AJ; Darby DG; Maruff P; Makdissi M; Mccrory P

/Title

Arch Clin Neuropsychol. 2014; 29(5):432-41

* The baseline method was found to be more sensitive than the normative method, and both methods had high specificity and overall correct classification rates
* This suggests that while the normative method identifies most cases of recent concussions, the baseline method remains a more precise approach to assessing concussion-related cognitive impairments.

Office Management:

* Cognitive assessment
  * Sufficient data regarding the reliability, validity, and clinical utility of the neuropsychological instruments within the baseline model are still lacking for the most part.
  * no identified prospective, controlled study has shown that athletes display neurocognitive impairment after symptoms have resolved
  * such testing does not add value to return-to-play decisions when athletes are still symptomatic
  * Baseline testing in children <17 years may need to be repeated more often than yearly

Office Management:

* Symptom assessment
  * Because objective medical evidence is often lacking after concussion, systematic review of symptoms as reported by both the patient and parent is an indispensable part of medical decision making
  * multiple Post Concussion Symptom (PCS) checklists and scales have been developed and published to assist with this undertaking

Office Management:

* Symptom assessment
  * The Concussion Symptom Inventory (CSI) is n empirically based PCS measure that could be readily used by the primary care provider
  * derived from >16 000 high school and college athletes and includes normative data from >600 athletes with concussion
  * PCS are not unusual among individuals without concussion. Consequently, all reports of PCS need to be Interpreted In view of the overall clinical evaluation, using pre-injury data when available

Office Management:

* There is not data to support prioritizing symptom treatment.
* Which symptoms are the most important to treat?
* Correcting sleep disturbance when present may improve headaches, memory problems, irritability, etc.
* Treatment of headaches is generally the first priority of the patient.
* Analgesics (NSAIDs or acetaminophen) are usually sufficient.

Does Analgesic Overuse Contribute to Chronic Post-traumatic Headaches in Adolescent Concussion Patients?
Geoffrey L. Heyer MD, Syed A. Idris MD *Pediatric Neurology 50 (2014) 161-168*

* Retrospective chart review of 104 consecutive patients referred to Neurology for chronic post-concussive headaches over 16 months.
* 77 met criteria for chronic post-traumatic headache.
* 54 (70.1%) met criteria for medication overuse headache. (only simple analgesics were overused).
* 37 of 54 (68.5%) had resolution
* of headaches or improvements to preconcussion headache patterns after discontinuing analgesics

Does Analgesic Overuse Contribute to Chronic Post-traumatic Headaches in Adolescent Concussion Patients?
Geoffrey L. Heyer MD, Syed A. Idris MD *Pediatric Neurology 50 (2014) 161-168*

* CONCLUSION: Excessive use of analgesics postconcussion maycontribute to chronic post-traumatic headaches in some adolescents. Management of patients with chronic posttraumatic headache should include analgesic detoxification when medication overuse is suspected.

Return to school

* In general, children should be held out of school following a concussion until symptoms have resolved.
  * Cognitive rest, especially in the first seven days, can reduce the severity and duration of symptoms.
  * If symptoms are more persistent (>2 weeks), return to school may be advisable.

Cognitive Rest

Brown, et al. *Pediatrics*, February 2014

* 335 patients presenting to a concussion clinic, ages 8-23 years, who presented within the first 3 weeks following the initial injury
* asked each participant to rate their cognitive activity, ranging from minimal activity to full activity
* Those in the highest quartile of activity took 100 days to recover.
* Those in the lower 3 quartiles took 20-50 days to recover

Return to school

* Typical short term accommodations:
  * No Physical Education.
  * Delay testing.
  * Limit intensive academic projects (term papers, etc).
  * Limit homework
  * Limit school hours (1/2 days)

Return to school

* Longer term accommodations:
  * Students with persistent cognitive deficits after concussion may require:
    * Assistance with note taking
    * Extra time for tests and/or assignments
    * Reduced stimulation atmosphere for tests
    * Advance notes to preview before class sessions
    * Reduced workloads
    * Shortened school day

Return to Play: When

Return to Play: When

When in doubt, sit them out!

Return to Play

* "It was unanimously agreed that no RTP on the day of concussive injury should occur. There are data demonstrating that at the collegiate and high school levels, athletes allowed to RTP on the same day may demonstrate NP deficits postinjury that may not be evident on the sidelines and are more likely to have delayed onset of symptoms."

* McCory et al **Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012** *Br J Sports Med* 2013

Return to Play: When

* Caution must be taken.
* Repeated concussions have cumulative effects
* repeated concussions result in increased vulnerability to additional injury--3-6 times
* Animal models are consistent with cumulative effects with the hippocampus being particularly vulnerable
* the risk-benefit analysis in younger athletes is considerably different from that in adults, weighted much more heavily toward potential loss or future functional disruption as opposed to immediate gain from returning to competition

Return to Play: When

* No signs or symptoms of any kind are apparent at rest or during exertion
* Neurologic examination is normal
* Neuroimaging is unremarkable if performed

Return to Play: How

* Because of possible symptom aggravation with increased levels of exertion, an athlete should return to play in a gradual, stepwise fashion rather than in a more abrupt manner (Ie, out 1 day, return to play the next)
* Once an athlete is judged free of all symptoms at rest, they should make a progression through a sequence of steps, with the athlete needing to remain symptom-free with- out medication throughout each step before proceeding and returning to play

Graded Return to Play

Rehabilitation stage	Functional exercise at each stage of rehabilitation	Objective of each stage
1. No activity	Symptom limited physical and cognitive rest	Recovery
2. Light aerobic exercise	Walking, swimming or stationary cycling keeping intensity <70% maximum permitted heart rate 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, eg, passing drills in football and ice hockey May start progressive resistance training	Exercise, coordination and cognitive load
5. Full-contact practice	practice Following medical clearance participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6. Return to play	Normal game play	

Retirement from Contact Sports

- No current evidence-based guidelines
- Substantial Symptom Burden
- Decreasing Force needed to Cause Injury (Increased susceptibility)
- Persistent changes from baseline in Cognition or Personality

Retirement from Contact Sports

(Cantu, et al. *Curr Sports Med Rep*, 2009)

* 3 concussions in a individual season
  OR
* > 3 mo of post-concussive symptoms

…. "should strongly consider a prolonged amount of time away from contact sports."

Retirement from Contact Sports

* Even the first concussion may force retirement.
* The decision has to be individualized.
* The more we know, the more we know we don't know

WHEN IN DOUBT, SIT THEM OUT!

Thank You