Concussion Training Day

Evaluation of Concussion and PCS: Medical Perspective

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Objectives

- Understand key elements that make up the Physical Examination
- Be aware of the reliability of these elements
- Adapt these elements to suit the clinical situation
- Be aware of differences in children

The initial approach

No Injury | Concussion | Emergency

McCrory, P. October 27th 2016- 5th International Consensus Conference on Concussion in Sport, What is the Definition of concussion?

The Physical Examination of Concussion: A Paradigm Shift in Diagnosis

- Clinical tools must be reliable and readily adaptable to suite the clinical situation
- Approach must be structured, following a hierarchy of assessment
- Use tasks that commonly precipitate or exacerbate concussion symptoms
- Fall within two clinical domains
  1. Screening Examination
  2. Focussed Concussion Examination

Screening Examination

Initial evaluation- Assess ABC's (Primary survey), Cervical spine, Consciousness, Mental status (MMSE), Seizures, Focality

EMS response- Repeated vomiting, Severe or progressive headache, Seizure, Abnormal gait, Slurred speech, Weakness or numbness in extremities, Unusual behavior, skull fracture, AMS, Somethings not quite right

Clinical decision rules for imaging

Clinical history- Mechanism of injury (SCAT)

Obtain some clinical history from observers
Assess for concussion if head, face, or neck injuries present
Prior concussion history—inquire about previous symptoms of concussion and number of concussions.

Evaluate for symptoms (Pocket CRT/SCAT)

Screening Examination

Neurological exam- Neck exam, 3' neurologic exam; assess pupillary reflexes, cranial nerves, motor strength; perform gait/station tests for balance (Romberg), palpate for neck pain

Mental status (SAC/SCAT)

Attention span (immediately repeat four numbers forwards; at 2 minutes, repeat months of year backwards or repeat five digits forwards and backwards)
Short-term memory (three objects at 5 minutes)
Assess for posttraumatic (retrograde) amnesia (Pocket CRT)

i. "What team are you playing?"
ii. "What is the score of the game?"
iii. "What are the colours of the uniforms of the team you are playing?"

Assess for anterograde amnesia
Assess long-term memory

Secondary survey- lacerations, faciomaxillary & other system injury

Focussed Concussion Examination

Four pillars

- History
- Cognitive function ⟹
- Vestibular Ocular control
- Balance control

Focussed Concussion Examination

History

Define injury characteristics

- Mechanism of injury
- Post-injury symptoms

Define risk

- Co-morbidities
- Risk factors

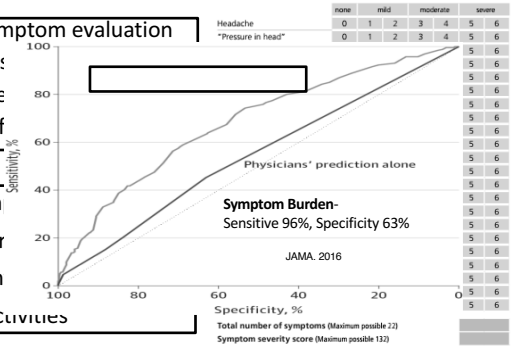
Post-concussion Symptom Scoring

Symptom evaluation

- 22 s
- Like
- Self

Sym

- Cir
- En
- Activities



	none	mild	moderate	severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
						5	6
						5	6

Focussed Concussion Examination

History

Co-morbidities & Risk factors

Previous concussion, headaches, ADHA, LD, psychiatric conditions, previous spinal injury, neuro-opthalmologic conditions, other conditions e.g. epilepsy, neuro-structural

Scopaz. Sports Health 2013

Family history

Past medical history

School and social factors

Inserson G, October 28th 2016- 5th International Consensus Conference on Concussion in Sport, What are the key modifiers for concussion outcomes?

Focussed Concussion Examination

Cognitive function

Orientation (time, place or person)

Concentration (digital backwards)

Memory (word tasks)

Reaction time

Cognitive function

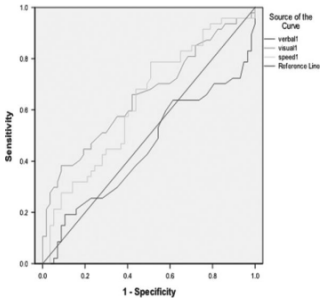
Standardized Assessment of Concussion **(Sensitivity 94%, Specificity 91%)**

- Orientation
- Immediate memory
- Concentration
- Delayed recall

Maddock Q's

Abbreviate-Westmead Post-Traumatic Amnesia Score A-WPTAS Hayter. Appl NeuroPsy: Adult 2016

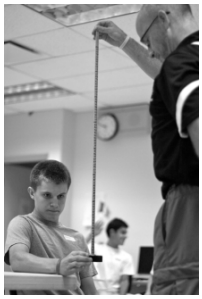
Cognitive performance- Computer



Lau. Neurosurgery. 2012; Schatz. Am J Sports Med. 2013

McCrea, M. October 27th 2016- 5th International Consensus Conference on Concussion in Sport, What advanced or novel tests can assist in the evaluation of concussion?

Cognitive performance- Reaction time, clinical



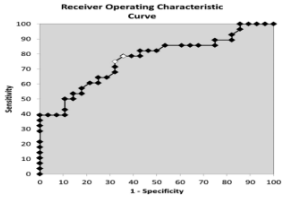
RT (ms) = 1000x √(2 x distance in cm)/(980cm/s2)

Drop stick test

Sits, dominant hand neutral over desk

8 recorded dropping of stick

Record distance dropped

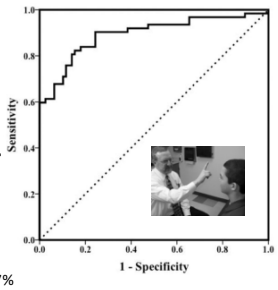


Eckner. Br J Sports Med 2014;48:112-118

Focussed Concussion Examination

Vestibular Ocular control

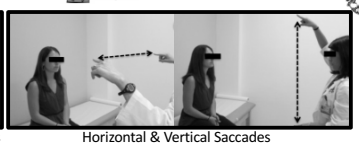
- Visual acuity
- Smooth pursuits
- Eye Saccades
- Near Convergence
- Vestibulo-ocular reflex
- Visual Motor Sensitivity



Sensitivity 91.7%, Specificity 81.7%

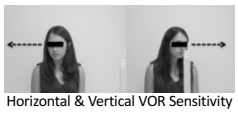
Mucha Am J Sports Med . 2014; McDevitt In J Sp Med 2016; Anzalone Am J Sports Med. 2016

Horizontal & Vertical Pursuits

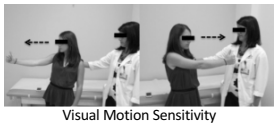


Horizontal & Vertical Saccades

Near Point Convergence



Horizontal & Vertical VOR Sensitivity



Visual Motion Sensitivity

Focussed Concussion Examination

Balance control

- Station
- Single leg stance
- Tandem stance
- Tandem gait
- Dual tasking

Balance Error Scoring System

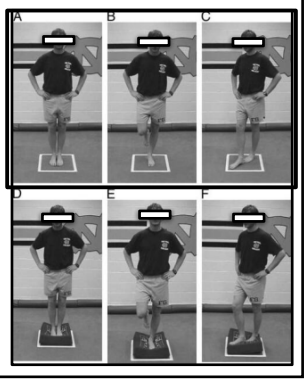
BESS
Sensitivity 91%, Specificity 64%

m-BESS
Sensitivity 91%, Specificity 71%

Guskiewicz. Clin Sports Med. 2011; Chandrasekhar NeuroRehabilitation 2013

m-BESS: Balance Error Scoring System

- Postural Stability on a firm surface
- 20 seconds each
- Count errors to score
  - Eyes opening
  - Movement
  - Hands off hips
- Unable to hold or a minimum of 5sec, maximum score
- Abnormal response, ≥5 during each trial



m-BESS
Sensitivity 95%, Specificity 71%

Combining m-BESS/VOMS-
Specificity 96%, accuracy 94.4%

McDevitt Int J Sp Med 2016

Balance Exam- Tandem walking / Dual-tasking

1. Tandem walking- forward
2. Tandem walking- backwards

Specificity of 91%

On Field Assessment

- If unconscious, ABCs, C-spine, Seizure, Level of consciousness, Focality

- Important observations
  - Unresponsive, LOC
  - Clutching or shaking head
  - Slow to get up
  - Vacant staring or gaze
  - Gait ataxia
  - Seizure like activity

Patricios J, October 27th 2016- 5th International Consensus Conference on Concussion in Sport, What are the critical sideline elements for a diagnosis?

Sideline assessment

- Is there likely to be a structural brain injury?
- Is there likely to be a concussion? **SCAT-4** ⟹

SCAT elements-
Observed signs
Symptom reporting
SAC elements
- Orientation
- Immediate memory
- Concentration
- Delayed recall

Balance
Neck assessment

⇒

High yield
Spontaneous nystagmus
Vertical eye discordance
Dynamic vision
Romberg/m-BESS
Positional maneuvers
Neck examination

Fedderman N, October 27th 2016- 5th International Consensus Conference on Concussion in Sport, What domains of clinical function should be assessed post-injury?

Any one symptom or any one sign should result in immediate exclusion and withdrawal from the game

No next day return until re-evaluated

Echemendia R. October 27th 2016- 5th International Consensus Conference on Concussion in Sport, What measures should be added to SCAT?

Emergency Department Assessment

Exclude significant injury- trauma examination

- Neuroimaging

Make a diagnosis of concussion

- Focused Concussion Exam
- Document neck pain

Commence a short period of rest

Organise appropriate follow-up- HEAD BUMPS

Primary care- Subacute assessment

Rule out other injury and/or potential subtle structural brain injury

Confirm the diagnosis, focused concussion exam

Define the deficits, systems not pathway specific

Tailor treatment

Consider need for referral to a specialist service

Complex concussion / Post Concussion Syndrome

Physiotherapy
Physical therapies
Vestibular therapies

Neurology
Neurosurgery
Rehabilitation

Cardiology
Exercise therapy
Sleep medicine

Psychiatric
Psychological
Behavioural therapy

McCrory, P. October 27th 2016- 5th International Consensus Conference on Concussion in Sport, What is the Definition of concussion?
Moran, South Med J 2015

Orthostatic / Dynamic vital signs

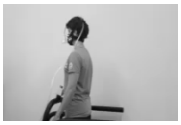
Orthostatic
- Hypotension
- Tachycardia
- Heat intolerance

Dynamic, exercise induced
- Tachycardia
- Autonomic dysfunction

Exercise intolerance

Help differentiate from Concussion mimics

Provocation testing to risk stratify patients



Concussion

↓

Initial Assessment

↓

Subacute phase physiology

↓

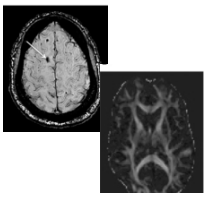
Secondary Assessment

Graded exercise test		Graded exercise test	
↓	↓	↓	↓
Recovered	Physiologic PCD	Physiologic PCD	Target symptom
↓	↓	↓	↓
Recovery procedures	Subthreshold Exercise Program		Targeted therapy

McCrea, M. October 27th 2016- 5th International Consensus Conference on Concussion in Sport, What advanced or novel tests can assist in the evaluation of concussion?

Tertiary Imaging in complex concussion

- Possible indications for imaging-
  - Suspicion of IC injury
  - Dramatic worsening of symptoms
  - Prolonged symptom
- High quality MRI, MRA/MRV, DTI
  - Micro-structural injury that may suggest prolonged recovery or vascular injury
  - DAI, vascular injuries and WM structure
  - Problem, highly sensitive for WMT abnormalities (98%) but not very specific (45%)
- PET scanning for dementia



Cat scans are for felines. I will give your dog a pet scan

McCrea, M. October 27th 2016- 5th International Consensus Conference on Concussion in Sport, What advanced or novel tests can assist in the evaluation of concussion?

Paediatric concussion- Special considerations

1. Physiological development
2. Impact forces and protective ability
3. Physical and cognitive recovery
4. Effects on school and learning
5. Everyday environmental influences and demands
6. Potential for long-term sequelae

Davis G. 28th October 28th 2016- 5th International Consensus Conference on Concussion in Sport. What is the difference in concussion management in children as compared to adult?

Catastrophic injury Second impact

- **Second Impact Syndrome-** genetic basis / Ca^{++} channelopathy?
  - CACN1A mutation, potential for cerebral oedema after a relatively minor brain injury, familial hemiplegic migraine

Kors. Ann Neurol 2001;49:753-760

Carrera Neurology *1999:53:1 26; doi:10.1212/WNL.53.1.26; 1526-632X*

- Athletes carrying a specific genotype (CACNA1E rs704326) have a much greater risk of a prolonged recovery following concussion
  - History of migraine increases the risk of severe injury or prolonged recovery

McDevitt. AOSSM March 2016

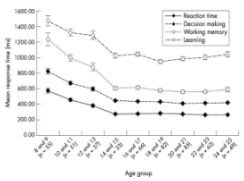
- **Brain impact**, amplified in young brains
  - Increased of Ca^{++} and Na^{+} influx induced by glutamate-triggered over activation of the NMDA receptors & AQP4 mediated oedema

Atkinson J. Mayo clin Proc 2000

Developmental conundrum

Integrate unique elements into assessment

- Developmental
- Medical
- Psychological
- Family / Environmental
- Academic / School



Standardised Assessment of Concussion- >6 years

A-WPTAS- > 6 years

Davis G. BJSM 2014; Grubenhoff. Pediatrics 2010; Tesson et al Emerg Med Australas 2016

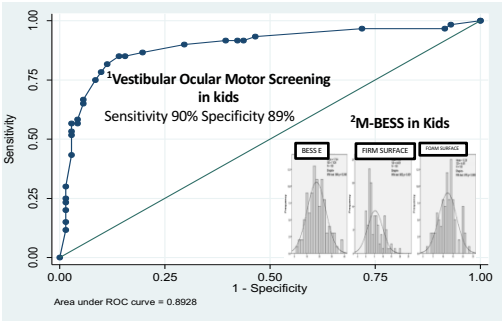
Multimodal assessment

Developmentally adapted assessment

- Cognition
- Balance
- Strength
- Agility / Motor skills
- Social / Psychological / School

Gioia et al. Brain Injury 2015; Reed et al. J. Vis. Exp., e51892, 2014

[3]Condensed model of care including GXT



[1]Ellis. J neurosurg Pediatr 2015, [1]Anzalone Am J Sports Med. 2016; [2]Khanna Sports Health 2015; [3]Browne et al Pediatrics 2016

What characteristics in kids determine RTA?

- Adolescents with headache on ED admission, requiring hospitalisation at ED encounter, at risk persistent PCS

Babcock JAMA Pediatr 2013

- Subacute GXT (2 days of rest)
  - Exercise tolerant- commence activity, active rehab, normal recovery
  - Exercise intolerant- facilitated activity, progressive rehab, slow recovery
  - Extreme exercise intolerant, extended rest, facilitated activity, rehab, very slow recovery

Browne et al Pediatrics 2016

- Westmead step test ⟹

Bogg. Ped Ex Science 2016

Take home messages

- PE is central to the assessment of concussion
  - tools we use need to be adapted to suit the clinical situation
- Complex concussion
  - higher level of evaluation is often needed, this best undertaken in a referral centre with appropriate interdisciplinary support systems
- Children are different
  - Risk can be mitigate through early diagnosis, effective treatment and education