Ring My Bell! Concussion Physiology and Care

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http://www.clinicalparamedicine.com
How Important of a Problem are Concussions?
1.6-3.8 M Concussions Annually in US

Estimated 50% not reported

DOI: [10.1097/HTR.0000000000000503](10.1097/HTR.0000000000000503)

1.2% = 150,000
Self Reported Recovery...

40% still had neuropsych deficits!
<table>
<thead>
<tr>
<th>Disorder</th>
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<tbody>
<tr>
<td>Mood disorders</td>
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<tr>
<td>Learning disabilities</td>
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<tr>
<td>Attention disorders</td>
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<tr>
<td>Migraines</td>
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<tr>
<td>Memory deficits</td>
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<tr>
<td>Depression / suicide</td>
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</table>
Traumatically induced transient disturbance of brain function that ... is a subset of mild traumatic brain injury which is classified based on acute injury characteristics at the less severe end of the brain injury spectrum.

World Health Organization Definition

• Confusion / disorientation
• LOC < 30 min
• Post-trauma amnesia < 24 hrs
• Transient neuro abnormalities

GCS 13-15 @ 30 minutes or at ER
Concussion Anatomy & Pathophysiology
Brain Anatomy

- Cerebrum
- Ventricle
- Falx cerebri
- Cerebellum
- Brain Stem
- Spinal Cord
Blood Brain Barrier

- Basal lamina
- Endothelial cell
- Perivascular space
- Capillary lumen
- Tight junction
- Pericyte
- Astrocyte foot process
Forces

- Contact Force
- Inertial Force
Contact Force
Inertial Force: Acceleration – Deceleration
Inertial Forces

Linear

Rotational
Neuron Membrane Disrupted
Calcium causes neuron damage / death
↑ Glucose consumption

Restores balance

↓ Glucose metabolism

Can last up to 7-10 days
Axon stretching $\rightarrow$ increased reaction time

Shear forces
Inflammatory cascade

Localized Acidosis

Permanent Neuron Dysfunction / Death

Clinically: permanent deficits to CTE
Clinical Effects
Clinical Effects

- Mood Disturbance
- Headache
- Frontal Lobe Dysfunction
- Vestibular / Ocular
Clinical Effects

- Mood Disturbance
- Headache
- Frontal Lobe Dysfunction
- Vestibular / Ocular

- Sleep
- Depression
- Anxiety
- PTSD
Clinical Effects

- Mood Disturbance
- Headache: Similar to migraine symptoms
  - Photophobia (light sensitivity)
  - Phonophobia (sound sensitivity)
  - Vomiting
- Frontal Lobe Dysfunction
- Vestibular / Ocular
Clinical Effects

- Mood Disturbance
- Headache
- Frontal Lobe Dysfunction
- Vestibular / Ocular

- Attention
- Focus
- Irritability
- Memory
Clinical Effects

- Mood Disturbance
- Headache
- Frontal Lobe Dysfunction
- Vestibular / Ocular

- Dizziness / vertigo
- Impaired balance
- Diplopia
- Blurred vision
On-Field assessment
Initial Approach

- Airway
- Breathing
- Circulation
- Disability
- Exposure
- Immobilization
Imaging Indications

- Focal neuro deficits
- Post trauma amnesia
- Altered mental status
- Persistent vomiting
- Persistent headache
- GCS < 15

- Seizures
- LOC controversial
- Age > 60
- Drug/ETOH
- Coagulopathy
- Cervical pain
Sideline Concussion Assessment

- Alertness
- Memory & Attention
- Vestibular Function
- Ocular Function
History: Suspect Concussion

- Confused
- Dazed
- Mentally “foggy”
- Irritable
- LOC
- Slow to get up from hit
- Blank stare
<table>
<thead>
<tr>
<th>List</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word 1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Word 2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Word 3</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Word 4</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Word 5</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
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</table>

Immediate Memory Total Score \__________ / 15
(Note: Subject is not informed of delayed recall testing of memory)

3) CONCENTRATION:

- Digits Backward: (If correct, go to next string length. If incorrect, read trial 2. Stop after incorrect on both trials.)
  - 4-9-3: 6-2-9
  - 3-8-1-4: 3-2-7-9
  - 6-2-9-7-1: 1-5-2-8-6
  - 7-1-8-4-6-2: 5-3-9-1-4-8

- Months in Reverse Order: (entire sequence correct for 1 point)
  - Dec-Nov-Oct-Sep-Aug-Jul: 0
  - Jun-May-Apr-Mar-Feb-Jan: 0

Concentration Total Score \__________ / 5

EXERTIONAL MANEUVERS
(when appropriate):
- 5 jumping jacks
- 5 sit-ups
- 5 push-ups
- 5 knee bends

4) DELAYED RECALL:

- Word 1: 0
- Word 2: 0
- Word 3: 0
- Word 4: 0
- Word 5: 0

Delayed Recall Total Score \__________ / 5

SUMMARY OF TOTAL SCORES:

- ORIENTATION: \__________ / 5
- IMMEDIATE MEMORY: \__________ / 15
- CONCENTRATION: \__________ / 5
- DELAYED RECALL: \__________ / 5
- OVERALL TOTAL SCORE: \__________ / 30

NEUROLOGIC SCREENING:

- Loss of Consciousness: (occurrence, duration)
- Retrograde & Posttraumatic Amnesia: (recollection of events pre- and post-injury)
  - Strength:
  - Sensation:
  - Coordination:
Alertness: Maddock’s Questions

- Where are we?
- What quarter/half/period is it right now?
- Who scored last in the game/period?
- Who did we play in the last game?
- Did we win the last game?
Vestibular Function

Tandem Gait

Finger to Nose
Ocular Response

Extraocular Movements

Near Accommodation

Abnormal:
Diploplia > 2.5 inches away
Blurriness > 6 inches away
Ocular Response

Saccade

Vestibulocular Reflex

Normal

Abnormal
Return to Play

No same day return
Return to Play Protocol

Return To Play
General Guide

1. NO ACTIVITY (Recovery)
   Complete Physical and Cognitive Rest until Medical Clearance
   - Symptom Free for Next 24 Hours?
     - Yes: Begin Step 2
     - No: Continue Resting

2. LIGHT AEROBIC EXERCISE
   (Increase Heart Rate)
   - Walking, Swimming, Stationary Cycling
   - Heart Rate <70% - 15 min
   - Symptom Free for Next 24 Hours?
     - Yes: Move to Step 3
     - No: Rest Further until Symptom Free

3. SPORT SPECIFIC EXERCISE
   (Add Movement)
   - Skating Drills, Running Drills
   - NO Head Impact Activities
   - Health Care Specialist Approval Required to "Return to Play"
   - Heart Rate <80% - 45 min
   - Symptom Free for Next 24 Hours?
     - Yes: Move to Step 4
     - No: Return to Step 2 until Symptom Free

4. NON-CONTACT TRAINING DRILLS
   (Increased Exercise, Coordination & Attention)
   - Progress to Complex Training Drills
   - (e.g., Passing Drills, etc)
   - May Start Resistance Training
   - Heart Rate <90% - 60 min
   - Symptom Free for Next 24 Hours?
     - Yes: Move to Step 5
     - No: Return to Step 3 until Symptom Free

5. FULL CONTACT PRACTICE
   - [Restore Confidence & Assess Functional Skills]
   - If Symptom Free
   - Return to Normal Training Activities
   - Symptom Free for Next 24 Hours?
     - Yes: Return to Play
     - No: Return to Step 4 until Symptom Free

Source: Springfield South County Youth Club
Graduated Return to School Protocol

RECOVERY STAGE 1
- Complete Full Physical and Cognitive Rest and Medical Consultation
- No School Attendance
- Decrease Technology Usage
- No Exercise or activities
- No Physical Education Class
- No Extra-curricular Activities
- Rest at Home

RECOVERY STAGE 2
- Return to School with academic accommodations
- Complete Full Physical and Cognitive Rest and Medical Consultation
- No School Attendance
- Decrease Technology Usage
- No Exercise or activities
- No Physical Education Class
- No Extra-curricular Activities
- Rest at Home

RECOVERY STAGE 3
- Continue school part time
- Return to School with academic accommodations
- Complete Full Physical and Cognitive Rest and Medical Consultation
- No School Attendance
- Decrease Technology Usage
- No Exercise or activities
- No Physical Education Class
- No Extra-curricular Activities
- Rest at Home

RECOVERY STAGE 4
- Full Recovery to physical
- Return to School
- Complete Full Physical and Cognitive Rest and Medical Consultation
- No School Attendance
- Decrease Technology Usage
- No Exercise or activities
- No Physical Education Class
- No Extra-curricular Activities
- Rest at Home

Symptoms of Headaches, Sensitivity to Light/Sound, Fogginess, Tension, etc.

Date Acquired:

Reference: HeadHealth Initiative, Return to Full Activity After Concussion www.headhealthinitiative.org