It Takes A Team: Multidisciplinary Management of Sport-Related Concussion

February 16, 2017
APTA Combined Sections
San Antonio, TX
Objectives

- To discuss the importance of a multidisciplinary approach to the treatment of athletes with a sports related concussion.

- To educate about the roles of the members of the multidisciplinary team in regards to treatment of athletes after sports related concussion.

- To discuss the role of the sports physical therapist as an integral part in the multidisciplinary team.
Outline

• Case Presentation

• Immediate Assessment & Management of Concussion – Tiffany McGuffin

• Medical Management for SRC – Damond Blueitt

• Nutritional Management for SRC – Brittney Bearden

• Physical Therapy Management for SRC – Bobby Jean Lee

• Athletic Training Management for SRC – Tiffany McGuffin

• Panel discussion and Q&A
Patient Management Algorithm

1. On Field Assessment by ATC or MD
   - Physical Therapy
   - Athletic Trainer
   - Return to Play

2. Office Assessment by MD or PA
   - Adjunct Treatment
     - Nutritional Consult
     - Developmental Optometry
     - Cognitive Therapy

3. Nutritional Consult
   - Neuropsychology

4. Developmental Optometry
   - Neurology

5. Cognitive Therapy
   - Speech Therapy
Case Example

- 16 yo Female Soccer Midfielder
- Injury occurred with going up to head the ball and colliding with another athlete
- Primary complaints of dizziness, headaches, difficulty focusing, light & sound sensitivity and neck pain
- Prior history of concussion 2 years ago
- No LOC
- No history of ADHD or learning disabilities
Immediate Assessment & Management for Sports-Related Concussion

Tiffany McGuffin, MS, ATC, LAT
February 16, 2017
APTA Combined Sections
San Antonio, TX
On-Field Evaluation

- ABCs
- Rule out neurological and C-spine pathologies
The sudden change in cerebral velocity elicits neuronal shearing, which produces changes in ionic balance and metabolism. When accompanied by clinical signs and symptoms, these changes at the cellular level result in a mild traumatic brain injury.

Functional vs. Structural
Side-Line Evaluation

- Cranial Nerve Assessment
- SCAT
- BESS
- King Devick
- Terminal Gate
<table>
<thead>
<tr>
<th></th>
<th>E</th>
<th>V</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Best eye response</strong> (E)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No eye opening</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye opening in response to pain</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye opening to speech</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eyes opening spontaneously</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Best verbal response</strong> (V)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No verbal response</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inappropriate words</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confused</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oriented</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Best motor response</strong> (M)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>No motor response</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extension to pain</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal flexion to pain</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexion/Withdrawal to pain</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Localizes to pain</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obeyss commands</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Glasgow Coma score (E + V + M)**

15

GCS should be recorded for all athletes in case of subsequent deterioration.
Maddocks Score\textsuperscript{3}

"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)

<table>
<thead>
<tr>
<th>Question</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>What venue are we at today?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which half is it now?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Who scored last in this match?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What team did you play last week/game?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did your team win the last game?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Maddocks score**

Maddocks score is validated for sideline diagnosis of concussion only and is not used for serial testing.
# How do you feel?

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

<table>
<thead>
<tr>
<th>Symptom</th>
<th>none</th>
<th>mild</th>
<th>moderate</th>
<th>severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>&quot;Pressure in head&quot;</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Neck Pain</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nausea or vomiting</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Dizziness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Balance problems</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to light</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to noise</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling slowed down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling like &quot;in a fog&quot;</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>&quot;Don’t feel right&quot;</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty remembering</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Fatigue or low energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Confusion</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Drowsiness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Trouble falling asleep</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>More emotional</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Irritability</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sadness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nervous or Anxious</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total number of symptoms** (Maximum possible 22)

**Symptom severity score** (Maximum possible 132)

- Do the symptoms get worse with physical activity? Y N
- Do the symptoms get worse with mental activity? Y N

**Overall rating**: If you know the athlete well prior to the injury, how different is the athlete acting compared to his/her usual self? Please circle one response:

- No different
- Very different
- Unsure
- N/A
**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** 0 1

**Immediate memory**

<table>
<thead>
<tr>
<th>List</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Alternative word list</th>
</tr>
</thead>
<tbody>
<tr>
<td>elbow</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
<td>candle baby finger</td>
</tr>
<tr>
<td>apple</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
<td>paper monkey penny</td>
</tr>
<tr>
<td>carpet</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
<td>sugar perfume blanket</td>
</tr>
<tr>
<td>saddle</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
<td>sandwich sunset lemon</td>
</tr>
<tr>
<td>bubble</td>
<td>0 1</td>
<td>0 1</td>
<td>0 1</td>
<td>wagon iron insect</td>
</tr>
</tbody>
</table>

**Total**

**Immediate memory score total** 0 1

**Concentration: Digits Backward**

<table>
<thead>
<tr>
<th>List</th>
<th>Trial 1</th>
<th>Alternative digit list</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-9-3</td>
<td>0 1</td>
<td>6-2-9 5-2-6 4-1-5</td>
</tr>
<tr>
<td>3-8-1-4</td>
<td>0 1</td>
<td>3-2-7-9 1-7-9-5 4-9-6-8</td>
</tr>
<tr>
<td>6-2-9-7-1</td>
<td>0 1</td>
<td>1-5-2-8-6 3-8-5-2-7 6-1-8-4-3</td>
</tr>
<tr>
<td>7-1-8-4-6-2</td>
<td>0 1</td>
<td>5-3-9-1-4-8 8-3-1-9-6-4 7-2-4-8-5-6</td>
</tr>
</tbody>
</table>

**Total of 4**

**Concentration: Month in Reverse Order** (1 pt. per entire sequence correct)
- Dec-Nov-Oct-Sept-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan 0 1

**Concentration score** 0 1
**Neck Examination:**

<table>
<thead>
<tr>
<th>Range of motion</th>
<th>Tenderness</th>
<th>Upper and lower limb sensation &amp; strength</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Findings:</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Balance examination**

Do one or both of the following tests.

Footwear (shoes, barefoot, braces, tape, etc.)

---

**Modified Balance Error Scoring System (BESS) testing**

Which foot was tested (i.e. which is the **non-dominant foot**)  
Testing surface (hard floor, field, etc.)

**Condition**

<table>
<thead>
<tr>
<th>Double leg stance:</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single leg stance (non-dominant foot):</td>
<td>Errors</td>
</tr>
<tr>
<td>Tandem stance (non-dominant foot at back):</td>
<td>Errors</td>
</tr>
</tbody>
</table>

**And / Or**

**Tandem gait**

Time (best of 4 trials): ________ seconds
SCAT

7 Coordination examination
Upper limb coordination
Which arm was tested:
Left
Right
Coordination score of 1

8 SAC Delayed Recall
Delayed recall score of 5

Scoring Summary:

<table>
<thead>
<tr>
<th>Test Domain</th>
<th>Date:</th>
<th>Date:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Symptoms of 22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptom Severity Score of 132</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orientation of 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate Memory of 15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentration of 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delayed Recall of 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAC Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BESS (total errors)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tandem Gait (seconds)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordination of 1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**BESS Test**

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**Balance Error Scoring System (BESS)**

(Guskiewicz)

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**Balance Error Scoring System – Types of Errors**

1. Hands lifted off iliac crest
2. Opening eyes
3. Step, stumble, or fall
4. Moving hip into > 30 degrees abduction
5. Lifting forefoot or heel
6. Remaining out of test position > 5 sec

---

**SCORE CARD:**

<table>
<thead>
<tr>
<th>(# errors)</th>
<th>FIRM Surface</th>
<th>FOAM Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Leg Stance (feet together)</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Single Leg Stance (non-dominant foot)</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Tandem Stance (non-dom foot in back)</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

---

**Total Scores:**

**BESS TOTAL:**

---

Which **foot** was tested:  □ Left  □ Right (i.e. which is the **non-dominant** foot)

---

King Devick Test

DEMONSTRATION CARD

TEST I

TEST II

TEST III
When to Sit Them Out

- Symptom Presentation is not always immediate
- Second Impact Syndrome
Home Care and Referral

- Home Care
- ImPACT Testing
- Referral to MD in 48 hours
Case Example
16 yo Female Soccer Midfielder

- Immediate on the field assessment at the time of injury:
  - SCAT score = 78
  - BESS Test = 25
  - ImPACT Score
  - PCSS score = 37
- Referral to MD
References

- NATA Position Statement: Management of Sports Concussion
- https://kingdevicktest.com/
Medical Management for Sports-Related Concussion

Damond Blueitt, MD
February 16, 2017
APTA Combined Sections
San Antonio, TX
Agenda

- Discuss clinical assessment the concussed athlete
- Describe treatment strategies
- Discuss appropriate return to play/classroom protocols
Detailed History
Why It Matters

- Event
- Mechanism of injury (MOI)
- Symptoms and activity following injury
- Previous concussions
- Family history
- History of learning disorders
- Medical conditions
- Current medications
Symptom Checklist

- Allows the patient to share and rate their symptoms
- Allows physician to see subjective changes in symptoms with each follow up visit
Physical Exam

- Cognition Assessment
  - Orientation
  - Memory (Immediate and Delayed)
  - Concentration

- Neurological Assessment
  - Cranial nerves

- Cerebellar function
Balance Assessment

- Balance problems is commonly seen in athletes within 3 days of injury
  - Lovell, Collins et al. 2004

- Multiple screening tools
  - Single leg and tandem balance
  - BESS
  - Force plate testing
  - Sway balance

- *Most helpful with a baseline*
Vestibular-Ocular Screening

- Smooth Pursuits/ “H” Test
- Saccades
- Gaze Stability
- Response to Optokinetic Stimulation
- Accommodation
- Convergence

Mucha et al. 2013
## Vestibular/Ocular Motor Screening

The UPMC Vestibular/Ocular Motor Screening (VOMS) is a 5-minute physical exam designed to assess for concussion.

### UPMC Vestibular/Ocular-Motor Screening (VOMS) for Concussion

<table>
<thead>
<tr>
<th>Vestibular/Ocular Motor Test:</th>
<th>Not Tested</th>
<th>Headache 0-10</th>
<th>Dizziness 0-10</th>
<th>Nausea 0-10</th>
<th>Fogginess 0-10</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASELINE SYMPTOMS:</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smooth Pursuits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saccades – Horizontal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saccades – Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convergence (Near Point)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Near Point in cm):</td>
<td>Measure 1: _____</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Measure 2: _____</td>
<td>Measure 3: _____</td>
</tr>
<tr>
<td>VOR – Horizontal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOR – Vertical</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Visual Motion Sensitivity Test</td>
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</tr>
</tbody>
</table>

Symptoms reported by patient on 0-10 point scale.

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Neuroimaging

Most concussions do not necessitate neuroimaging

CT and MRI are most common

Functional MRI (fMRI)
- Altered brain activity

MR Spectroscopy (MRS)
- Metabolic changes in brain

Diffusion Tensor Imaging (DTI)
- Microscopic white matter disease
Computerized Neurocognitive Testing

- Multiple tests
- Only a tool to assist in concussion management
- ImPACT, Axom, & ANAM have similar test-retest reliability
  - Nelson et al. JINS. Jan 2016
- Diminishes when performed in community setting
  - MacDonald J and Duerson D. CJSM. July 2015
- ImPACT reliable for post-concussion serial assessments
  - Nakayama et al. AJSM. Aug 2014
Acute Management

- ONE SIZE DOESN’T FIT ALL!!!

- Must treat the factors you can control
  - Activity and symptoms following injury
Initial Rest Period

- Physical

To avoid further concussive events and worsening symptoms

- Cognitive

Limit or avoid school, reading, electronics, and busy environments

- Emotional

Avoid stressful environments and/or situations
Patients aged 11-22 years presented to ED within 24 hours of injury. 99 Patients were enrolled, 88 completed all study procedures and randomized to either

1. Strict rest for 5 days (no work, school or physical activity)
2. Usual Care, 1-2 days of rest

Conclusion: Recommending strict rest offered no added benefit over usual care

Thomas et al. Pediatrics 2015
Headache Treatments

- Tylenol
  - Most common
  - Safe

- NSAIDS
  - Short-term
Protracted Symptoms

- Most literature says 7-10 days
  - Misleading

- Longer duration for younger individuals

- Learning disabilities and attention disorders may be linked to prolonged recovery
  - Collins M et al. JAMA 1999

- Females tend to have slightly longer duration of symptoms
Protracted Symptoms

- Pre-existing migraines/headaches could possibly lead to protracted symptoms

- Slower recovery rates after second concussion
  - Slobounov S et al. Neurosurg 2007

- On-field dizziness related to protracted recovery in high school athletes

- Athletes that “play through it” are at risk for longer recoveries
Cognitive Recovery Time

- Data collected from literature search of HS & College athletes
- Only studies that reported symptom or cognitive recovery to the exact day (n=6)
- HS athletes self-reported symptom recovery was 15 days
- Collegiate athletes self-reported symptom recovery was 6 days
- Both showed cognitive recovery at 5 and 7 days

Reasons for Protracted Symptoms

- Bad luck
- Non-compliance
- Risk factors
- Complex concussions
Complex Concussions

- Persistent symptoms
- Specific sequelae
- Prolonged LOC
- Prolonged cognitive impairment
- Multidisciplinary management
- May take weeks to months to resolve!!!
Treatment of Protracted Symptoms

- Vestibular dysfunction
  - Vestibular rehab
    - 81% of pediatric patients (Ped Neurol Briefs 2015)

- Binocular vision abnormalities
  - Vision therapy
    - Convergence abnormalities have been reported in 47-64% of patients with concussions (Ventura et al. J Neuro-Ophthalmol 2015)

- Mood disorders
  - Counseling

- Prolonged cognitive impairment
  - Neuropsychological testing & speech therapy

- Post Concussive Headaches
Pharmacological Treatments

- No FDA-approved pharmacological treatments
- Several non-FDA approved pharmacological treatments used
- No medications have been shown to speed recovery
  - Beauchamp et al. Mol Med 2008
Pharmacological Therapy

- Is it necessary?

- Basically two situations when pharmacological treatments are favorable:
  - Treatment of SPECIFIC prolonged symptoms
  - Benefits of treatment outweigh the risks of medical complications or side-effects
Pharmacological Therapy

UPMC Concussion Program
Treatment/Rehabilitation Protocol

**Emotionality**
- SSRIs
  - Escitalopram (Lexapro)
  - Sertraline (Zoloft)

**Somatic Symptoms**
- Headaches Prophylaxis
  - Propranolol
  - Verapamil
  - Amitriptyline
  - Escitalopram (Lexapro)
  - Sertraline (Zoloft)

**Cognitive Symptoms**
- Neurostimulants
  - Amantadine
  - Methylphenidate
  - Atomoxetine (Strattera)

**Sleep Disturbance**
- Melatonin
- Trazodone

**Vestibular Therapy**

NOTE: *Off-label use
Referral Sources

- Neurology
- Neuropsychology
- Psychiatry
- Ophthalmology
- Pain Management
Return to Play (RTP)

- RTP plans should be sport specific and individualized
- Modification of RTP protocols is acceptable
  - Guskiewicz K, Putukian M. Presented Jan 2014. Atlanta, GA
- Complex concussions can require longer RTP protocols
- Symptoms dictate progressions
  - Harmon et al. BJSM. Jan 2013
- Final RTP decisions should be made by team physician
  - Harmon et al. BJSM. Jan 2013
Returning to Class

- Cognitive rest and slow reintroduction to academics is crucial
  - Hall et al. CJSM. May 2015

- Academic accommodations may be needed
  - Harmon et al. BJSM. Jan 2013

- Team approach is warranted
  - Medical, school, and family
Classroom Progressions

- No classes
- Half days with accommodations
- Full days with accommodations
- Full days with normal workload
Strategies to Help in Class Setting

- **Headache**
  - Frequent breaks, rest, and reduce stressors

- **Dizziness**
  - Avoid crowded halls

- **Visual**
  - Decrease screen time, use sunglasses, and auditory learning

- **Noise Sensitivity**
  - Avoid noisy areas and use ear plugs

- **Cognitive Impairment**
  - Decrease workload, extra time for work, and postpone/limit testing

Blood Biomarkers Research

- Clinical Assessment of Concussion, Biomarkers of Head Trauma, and Cerebrovascular Regulation: A comprehensive examination of mild traumatic brain injury (concussion) in youth and young adult athletes. (ongoing)
Case Example
16 yo Female Soccer Midfielder

- In Office Assessment 48 hours after injury:
  - Second concussion
  - PSS of 43

- Exam Findings:
  - Vestibulo-ocular dysfunction
  - Cognitive impairment
  - Poor caloric intake
  - CT head negative
Case Example
16 yo Female Soccer Midfielder

- Accommodations
  - Athletics
  - Academic

- Referrals
  - Vestibulo-ocular rehabilitation
  - Nutritionist referral
Agenda

- Role of Nutrition in Brain Function
- Nutrition Goals for Sports-Related Concussion
- Strategic Nutrient Intake
- Case Study
  - Phase 1
  - Phase 2
- Practical Takeaways
Role of Nutrition in Brain Function

- The human brain is metabolically active so requires a constant supply of energy
  - Accounts for ~25% of total body glucose utilization at rest
  - B vitamins, magnesium, iron, and manganese are required for glucose metabolism
- Requires a constant blood supply
  - Blood delivers oxygen, glucose, and other nutrients for proper cognitive function
  - Receives ~15% of cardiac output at rest
Role of Nutrition in Brain Function

- Neurotransmitters
  - Vitamins and minerals play a role in the synthesis of neurotransmitters

- Mood and Physiological Well-Being
  - Vitamin and mineral deficiencies have been linked to depression

- Good nutritional status is important for proper brain development and normal cognitive function
Nutrition Goals for Sports-Related Concussion

- Support recovery to return to sport as quickly as possible
- Reduce inflammatory response
- Strategic nutrient intake
- Weight maintenance
- Proper hydration
Strategic Nutrient Intake

- Omega-3 Fatty Acids
  - EPA + DHA
- Zinc
- Vitamin D
- Proper caloric intake and macronutrient balance
Omega-3 Fatty Acids

- EPA + DHA
  - Increases fluidity of cell membranes
  - Enhance cerebral blood flow
  - Reduce inflammation

- DHA supplementation increases DHA content in brains of TBI rats and reduce oxidative damage to the plasma membrane

- CDC estimates that up to 80% of the US population is omega-3 fatty acid deficient
Omega-3 Fatty Acids

- Food Sources:
  - Flaxseed
  - Chia seeds
  - Walnuts
  - Fish: salmon, tuna

- Supplements
  - Fish oil

- Recommendation: 3.0 g/d of EPA/DHA is recognized as safe by the FDA
Zinc

- Trace element with neurobiological roles needed in brain development and physiology
- Deficiency or excess can be harmful to the Central Nervous System
- Zinc concentration could be a marker of depression
- No clinical trials have been done to assess efficacy as treatment for mild TBI, but important to monitor status
Zinc

- **RDA:**
  - 14+ year old males: 11 mg
  - 14-18 year old females: 9 mg; 19+ year old females: 8 mg

- **Food sources:**
  - Oysters
  - Red meat
  - Poultry
  - Beans
  - Nuts
  - Breakfast cereals

- **Recommendation:** meet RDA; do not exceed Tolerable Upper Intake Level (UL) of 40 mg/d
Vitamin D

- Promotes normal brain development and function
- 65% of patients with varying degrees of TBI where vitamin D deficient
- Vitamin D deficiency may exacerbate inflammatory damage and behavioral impairment following brain injury
- Aging decreases capacity to synthesize Vitamin D in the skin from sun exposure
Vitamin D

- **RDA:**
  - 600 IU

- **Food sources:**
  - Fatty fish: salmon, tuna
  - Egg yolks
  - Milk
  - Cereal

- **Recommendation:** Monitor Vitamin D status, if supplement is needed dosage based on Vitamin D levels
Macronutrients

- Appropriate caloric intake to promote recovery while maintaining weight

- Increase calories with activity

- Carbohydrate
  - Best sources: whole grains, potatoes, sweet potatoes, beans, lentils, fruit, vegetables

- Protein: 1-1.5 g/kg of body weight
  - Best sources: chicken, fish, turkey, lean red meat, eggs, low fat dairy

- Fat
  - Best sources: nuts, nut butters, seeds, olive oil, canola oil, flaxseed, avocado, fish
Ketogenic Diet?

- Diet very high in fat with minimal carbohydrate intake
- Goal: provide an alternate energy source for brain
  - Ketone bodies from the breakdown of fat
- Has been effectively used to decrease both the incidence and severity of seizures in children with epilepsy
- More research is needed
Case Example
16 yo Female Soccer Midfielder

- Nutritional Plan and Education beginning at 48 hours after injury

- Nutrition Prescription:
  - 1700-1800 calories
  - 225 grams carbohydrates
  - 80 grams protein
  - 58 grams fat
Case Study - Meal Plan

- Breakfast: 2 eggs, ½ cup oatmeal, 1 cup berries, 1 cup milk
- Snack: 1 cup grapes, 15 almonds
- Lunch: Turkey sandwich made with 2 slices whole wheat bread, 3 oz turkey breast and 1/4 avocado. Sliced red bell peppers dipped in 2 T hummus
- Snack: 1 container vanilla Greek yogurt
- Dinner: 3 oz salmon filet, ¾ cup brown rice, 1 cup veggies sautéed in 1 T olive oil, 1 cup cubed pineapple
Case Study

- **Phase 1: 48 hours-7 days post concussion**
  - No activity = decrease caloric intake
  - Choose nutrient dense foods
  - Avoid processed/low nutrient foods
  - Supplement as needed
  - Hydration

- **Phase 2: 7 days-21 days post concussion**
  - Increase caloric intake with activity
  - Continue to focus on diet quality
  - Continue needed supplementation
  - Hydration
Foods to Avoid

- High sugar foods
- Processed foods
- Fried foods
- High salt foods
- Caffeine
- Alcohol
Practical Takeaways

- Encourage nutrient-rich, high quality food choices
  - Lean proteins
  - Quality carbohydrates
  - Healthy fats
  - Colorful fruits & vegetables

- Eat a meal/snack every 3-4 hours
  - Healthy snack options: nuts, Greek yogurt w/ berries, apple w/ peanut butter, cereal w/ milk, grapes w/ string cheese

- Omega-3 fatty acids rich foods or supplement
  - Food: salmon, tuna, cod, flaxseed, chia seeds, walnuts
  - Supplement: 3.0 g/d of EPA/DHA is recognized as safe by the FDA
References


Physical Therapy Management for Sports-Related Concussion

Bobby Jean Lee, PT, DPT, SCS, CSCS, USAW
February 16, 2017
APTA Combined Sections
San Antonio, TX
Agenda

- Overview of Physical Therapy:
  - Examination
  - Assessment
  - Treatment
  - Integration into RTP
Examination

- Subjective:
  - History of injury
  - PCSS

- Objective Exam:
  - Screening for Red Flags
  - Cervical Screen and Exam
  - VOMS
  - Special Tests
  - Balance Assessment
  - BPPV Tests
Subjective: History of Injury

- Date of Injury (longevity)
- Mechanism of injury
- Prior history
- Symptoms
  - Onset
  - Current
  - Provocation
  - Alleviation
- Affects
  - ADLs
  - School
  - Social interactions
  - Sleep
- Current treatment thus far
  - Medications
  - Rest
  - Activity level
Subjective: History of Injury

- Risk Factors for Prolonged Recovery:
  - Dizziness
    - Lovell et al. Applied Neuropsychology Feb 2006
  - Gender
    - Stone et al. Sports Health Jan 2017
  - Depression/anxiety
    - Chen et al. Arch Gen Psychiatry Jan 2008
  - Learning disorders
    - Collins et al. JAMA Sept 1999

- Prior concussions
  - Guskiewicz et al. JAMA Nov 2003

- Age
  - Field et al. J Pediatrics Feb 2003

- Migraines

- Mental status changes

- Total # of symptoms
  - Meehan et al. J of Pediatrics Sept 2013
Subjective: PCSS

- Post-Concussion Symptom Scale
  - 22 symptom scale
  - Rated from 0-6

- The PCSS has been shown to be highly reliable in healthy and concussed adolescents and young adults.
  - Lovell et al. Applied Neuropsychology Feb 2006

- Self reported symptoms via the PCSS have been shown to be associated with ongoing hemodynamic abnormalities in the brain
  - Chen et al. J Neurol Neurosurg Psychiatry Mar 2007
Objective: Screening for Red Flags

- Cranial nerve screening
  - CN 2, 3, 4, 6, 8
- Aural fullness & hearing changes
- Dizziness with straining
- Numbness or paresthesias
- Speech changes
- Changes in consciousness

- Spontaneous nystagmus
- Worsening Condition
- Visual Specialist
  - Pupil changes
  - Malalignment of eyes
  - Change in acuity
  - Flashing light
  - Double vision
Objective: Cervical Screen & Exam

- Vertebral Artery Test – rule out VBI
- AROM
- PROM
- Extensibility
- TTP
- Joint mobility
- Reproduction of symptoms
Objective: VOMS

VOMS SCORING SHEET

Symptoms on a 0-10 point scale

<table>
<thead>
<tr>
<th>Vestibular/Oculomotor</th>
<th>Type</th>
<th>Not Tested</th>
<th>Headache</th>
<th>Dizziness</th>
<th>Nausea</th>
<th>Fogginess</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Symptoms</td>
<td></td>
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<tr>
<td>Smooth Pursuit</td>
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<tr>
<td>Saccades (Vertical)</td>
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<tr>
<td>Convergence (Near Point)</td>
<td></td>
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<tr>
<td>Score#1</td>
<td>cm</td>
<td>Score#2</td>
<td>cm</td>
<td>Score#3</td>
<td>cm</td>
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<tr>
<td>VOR Horizontal</td>
<td></td>
<td></td>
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<tr>
<td>VOR Vertical</td>
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<tr>
<td>Visual Motion Sensitivity</td>
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</tr>
</tbody>
</table>

  - Sensitive for identifying concussed patients
  - VOR, VMS, and NPC ➔ high predicted probability
  - Positively correlated to PCSS
Objective: Special Tests
Alignment Test

- Assessing how well the eyes rest in midline
- Misalignment can lead to:
  - Double vision
  - Dysfunctional oculomotor control
Objective: Special Tests

VOR Tests

- Head Thrust Test
- Dynamic Visual Acuity

NORMAL VOR
Patient focused on examiners nose

After sharp turn to patient’s right, patient remains focused on examiners nose

ABNORMAL VOR
Patient focused on examiners nose

Corrective saccades
Objective: Special Tests

Other

- Cervicogenic Dizziness
- Fukada Step Test

Abnormal = rotation >30° and/or forward stepping >0.5 m
Objective: Balance Assessment

- Head Shaking Sensory Organization Test (HS-SOT)
  - Computerized exam
  - Adds head shake to EC on firm and EC on foam tasks
  - High sensitivity to vestibular system, but low specificity

<table>
<thead>
<tr>
<th></th>
<th>Young Adults</th>
<th>Older Adults</th>
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<tbody>
<tr>
<td>Condition 2, &lt; 50 y.o, n = 92</td>
<td>92.6 (2.3)</td>
<td>91.7 (2.3)</td>
</tr>
<tr>
<td>Condition 5, &gt; 50 y.o, n = 73</td>
<td>56.0 (12.7)</td>
<td>47.0 (14.2)</td>
</tr>
</tbody>
</table>

Pang et al., 2011
Objective: BPPV Tests

Dix-Hallpike
Objective: BPPV Tests

Log Roll

1. [Image of person lying on table]
2. [Image of person lying on table]
3. [Image of person lying on table]
4. [Image of person lying on table]
**Objective: BPPV Tests**

**Assessment**

<table>
<thead>
<tr>
<th></th>
<th>Right</th>
<th>Left</th>
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<tbody>
<tr>
<td>Posterior Canal</td>
<td>Up &amp; R torsional</td>
<td>Up &amp; L torsional</td>
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<tr>
<td>Anterior Canal</td>
<td>Down &amp; R torsional</td>
<td>Down &amp; R torsional</td>
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<tr>
<td>Cupulolithiasis</td>
<td></td>
<td>Persistent &lt;60 sec</td>
</tr>
<tr>
<td>Cupalithiasis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal Canal</td>
<td>L (Ageotrophic) R (Geotrophic)</td>
<td>R (Ageotrophic) L (Geotrophic)</td>
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</table>
Treatment

SRC

BPPV
- Canalithiasis
  - Horizontal Canal
    - Bar-B-Que Roll
    - Modified Brandt Daroff
    - Prolonged Position
  - Posterior Canal
- Cupulolithiasis
  - Horizontal Canal
  - Posterior Canal
- Central Adaptation

Oculomotor
- Substitution Exercises
- Gaze Stability Exercises
- Habitation Exercises

VOR

Motion Sensitivity

Cervicogenic
- Manual Therapy
  - STM
  - Postural
- Exercise Induced
  - Graded Exercise Program

Cognitive Deficits
- Balance and Proprioceptive Training
- Psychosocial Changes

Oculomotor Substitution Exercises
Gaze Stability Exercises
Habitation Exercises

Bar-B-Que Roll
Modified Brandt Daroff
Prolonged Position
Epley
Brandt Daroff
Quick Bar-B-Que Roll
Liberatory/Semont/Bradt Daroff

Cervicogenic Manual Therapy
STM Postural
Graded Exercise Program

Psychosocial Changes
BPPV

Canalithiasis

- Horizontal Canal
  - Bar-B-Que Roll
  - Modified Brandt Daroff
  - Prolonged Position

- Posterior Canal
  - Epley
  - Brandt Daroff

Cupulolithiasis

- Horizontal Canal
  - Quick Bar-B-Que Roll

- Posterior Canal
  - Liberatory/Semont
  - Bradt Daroff
Epley Maneuver
Liberatory/Semont Maneuver
Bar-B-Que Roll

1. 
2. 
3. 
4. 
5.
Treatment

**SRC**

- **BPPV**
  - Canalithiasis
    - Horizontal Canal
      - Bar-B-Que Roll
      - Modified Brandt Daroff
      - Prolonged Position
    - Posterior Canal
  - Cupulolithiasis
    - Horizontal Canal
    - Posterior Canal

- **Oculomotor**
  - Substitution Exercises
  - Central Adaptation

- **VOR**
  - Gaze Stability Exercises

- **Motion Sensitivity**
  - Habitation Exercises

- **Cervicogenic**
  - Manual Therapy
  - STM
  - Postural

- **Exercise Induced**
  - Graded Exercise Program

- **Cognitive Deficits**
- **Balance and Proprioceptive Training**
- **Psychosocial Changes**
Components
- Smooth Pursuit
- Saccades
- Vergence
  - Brock String

Oculomotor
- Substitution/Adaptation Exercises
- Central Adaptation

VOR
- Components
  - X1 exercises
  - X2 exercises
  - DVA exercises
- Gaze Stability Exercises

Motion Sensitivity
- Components
  - VOR cancellation
  - Transitional movements
- Habituation Exercises
Exercise Progression

- **Speed**
  - Athletes require VOR of up to 180-220 bpm

- **Direction of movement**

- **Background**
  - Plain
  - Busy
  - Dynamic

- **Distance**
  - Near (1-3’)
  - Far (>3’)

- **Time**
  - 30 sec
  - 1-2 min

- **# of Repetitions**

- **Stance**
  - Seated
  - Standing
  - Single leg
  - Tandem

- **Dynamic Movements**

- **Multitasking/Cognitive Tasks**
Treatment

SRC

- BPPV
  - Canalithiasis
    - Horizontal Canal
      - Bar-B-Que Roll
        - Modified Brandt Daroff
          - Prolonged Position
    - Posterior Canal
  - Cupulolithiasis
    - Horizontal Canal
    - Posterior Canal

- Oculomotor
  - Substitution Exercises
  - Central Adaptation

- VOR
  - Gaze Stability Exercises

- Motion Sensitivity
  - Habitation Exercises

- Cervicogenic
  - Manual Therapy
    - STM
    - Postural
  - Exercise Induced
    - Graded Exercise Program

Psychosocial Changes
- Cognitive Deficits
- Balance and Proprioceptive Training
- Exercise Induced

Texas Health
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Concussion Center
Cervicogenic

- Manual Therapy
  - STM
  - Postural

- STM
- Cervical and OA mobilizations
- Dry Needling
- Stretching
- Thoracic Mobility
- Rib Mobilizations
- Postural Exercises

Exercise Induced

- Graded Exercise Program
  - Sub-symptomatic
  - Buffalo Protocol
Treatment

SRC

BPPV
- Canalithiasis
  - Horizontal Canal
    - Bar-B-Que Roll
    - Modified Brandt-Daroff
    - Prolonged Position
  - Posterior Canal

- Cupulolithiasis
  - Horizontal Canal
  - Posterior Canal

Oculomotor
- Substitution Exercises

VOR
- Gaze Stability Exercises

Motion Sensitivity
- Habitation Exercises

Cervicogenic
- Manual Therapy
  - STM
  - Postural

Exercise Induced
- Graded Exercise Program

Central Adaptation

Cognitive Deficits

Balance and Proprioceptive Training

Psychosocial Changes
Cognitive Deficits
- Focus
- Memory
- Attention span
- Cognitive therapy

Balance and Proprioceptive Training
- EO/EC
- Firm/Foam
- Stance
- Dynamic movement
- Cervical Target Training
- Multitasking

Psychosocial Changes
- School Modifications
- Social Events
- Friends
- Support Group
- Motivations
- Goals

Parker et al. Clinical Biomechanics Jun 2005
Athlete Education

- HEP
- Nutritional considerations
- Sleep
- School adjustments
- Integration into social life
- Therapy progression and RTP
- Buy-in is KEY!!

Texas Health Ben Hogan Sports Medicine
Concussion Center
## Integration in RTP Progression

<table>
<thead>
<tr>
<th>Rehabilitation Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No activity</td>
</tr>
<tr>
<td>2. Light aerobic exercise</td>
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<tr>
<td>3. Sport specific exercise</td>
</tr>
<tr>
<td>4. Non-contact training drills</td>
</tr>
<tr>
<td>5. Full contact practice</td>
</tr>
<tr>
<td>6. Return to play</td>
</tr>
</tbody>
</table>
Case Example: Exam Findings
16 yo Female Soccer Midfielder

- PCSS = 35
- DVA = >3 line difference
- BPPV testing:
  - Positive R Dix-Hallpike
- TTP along B paraspinals, anterior scalenes, suboccipitals and UTs
### VOMS Scoring Sheet

**Symptoms on a 0-10 point scale**

<table>
<thead>
<tr>
<th>Vestibular/Oculomotor</th>
<th>Type</th>
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<th>Fogginess</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Symptoms</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Smooth Pursuit</td>
<td>5</td>
<td>3</td>
<td>0</td>
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<td>Dismetric</td>
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<tr>
<td>Saccades (Horizontal)</td>
<td>6</td>
<td>3</td>
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<td>0</td>
<td>R saccades</td>
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<tr>
<td>Saccades (Vertical)</td>
<td>3</td>
<td>2</td>
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<td>Convergence (Near Point)</td>
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<td>Score #1</td>
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<td>Score #3</td>
<td>Score#4 cm 26.5 cm</td>
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<td>7</td>
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<td>Visual Motion Sensitivity</td>
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<td>8</td>
<td>4</td>
<td>0</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Case Example: Initial Treatment
16 yo Female Soccer Midfielder

- BPPV: R Epley maneuver
  - ↓ dizziness
  - - Dix-Hallpike

- Cervicogenic:
  - Dry needling: B paraspinals, anterior scalenes, suboccipitals, UTs
  - STM: Suboccipital release
  - Thoracic spine (T3-T7) grade 5 mobilizations
  - HEP: Stretches and self-STM with a ball

- Oculomotor and vestibular deficits:
  - HEP: Smooth pursuit, Saccades, X-push ups, X1
Case Example: Progressions
16 yo Female Soccer Midfielder

- Seen for a total of 6 sessions over 3 weeks
- After 2 sessions athlete able to progress to busy backgrounds in functional positions
- Able to discontinue oculomotor exercises (smooth pursuit, saccades, and convergence) after 3 sessions
- Initiated higher level gaze stabilization and VMS exercises at 3rd session (X2 and VOR cancellation)
- Initiated running as beginning of Stage 3 of RTP at 6th session once cleared by MD
References

References

Athletic Training Management for Sports-Related Concussion

Tiffany McGuffin, MS, ATC, LAT
February 16, 2017
APTA Combined Sections
San Antonio, TX
Return to Play

- For patients who have gone through therapy, work with the therapist to determine what has been done and what needs to be done.

- For patients who did not need therapy, familiarize yourself with return to play protocol for the state and school.
Return to Play

- Contact sports vs. non-contact sports
- Integrating proprioception and sports specific drills
- Continued vestibular-ocular therapy for sports performance
Case Example
16 yo Female Soccer Midfielder

- ImPACT Score = At baseline
- BESS Test = 5
- Physical exam = WNL
- RTP Progression: Beginning at day 24 since initial injury
References

Questions?