Sports Medicine: Common Musculoskeletal Conditions and Concussions

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Declaration of Conflicts

I have no relevant:

✓ Conflicts of Interest
✓ Financial Disclosures

To declare with regards to this presentation or any of the material contained within this presentation.
Goals and Objectives

1. Identify the signs and symptoms that would help differentiate between a sprain, strain and possible fracture.
2. Identify the acute management for suspected sprains, strains and fractures.
3. Examine the clinical tools used to diagnose a suspected concussion.
4. Describe best practices in the management of concussion; to include return to learn and return to play guidelines.
5. Discuss the ancillary services available for patients who have sustained a concussion.

Musculoskeletal Injuries in Pediatric Athletes

Acute/Traumatic
- Strains
- Sprains
- Fractures
- Contusions

Chronic /Overuse
- Physeal Injuries
  - Epiphysis
    - Little League Shoulder
    - Gymnast Wrist
  - Apophysis
    - Osgood Schlatters
    - SLJ
    - Seve’s Disease
    - Little League Elbow
    - Pelvis/Low Back
- Tendonopathies
  - Inflammatory vs. Degenerative
- Fractures
  - Stress
  - Spondylosis
  - Spondylolisthesis

Journal of Paediatric and Child Health, 2016
Sports Health, 2017
Musculoskeletal Injuries

Sprains

- **Signs and Symptoms**
  - Vary with the degree of injury (e.g., no joint instability vs. gross instability and "empty" feel with stress testing)
  - Inflammation
  - Pain
  - Swelling
  - Ecchymosis (discoloration/bruising)
  - Impaired Function

- **Differential Diagnosis**
  - Fractures
  - Avulsion Fractures
  - Muscle Strains
    - Pain with Passive vs. Active ROM

- **Imaging**
  - X-Ray to rule out associated bony injury and/or avulsion fractures
  - MRI to identify partial or complete tearing of the ligament

- **Special Tests**
  - Ligamentous Stress Tests to isolate and identify the ligaments that are injured and the extent to which they may be injured
  - Ankle- Drawer
  - Knee- Varus/Valgus, Lachmans
  - Elbow- Varus/Valgus

- **Immediate Management**
  - PRICE (Protect, Rest, Ice, Compress, Elevate)
  - POLICE (Protect, Optimal Loading, Ice, Compress, Elevate)
  - Protect and Rest
    - Crutches
    - Bracing and Taping
    - Cam Walkers

- **Referral**
  - For Athletes, essential to have a supervised and guided rehabilitation program
    - Physical Therapy
    - Athletic Trainer
  - Orthopaedics
    - Grade 2 Injuries that you are unsure of or unfamiliar with
    - Grade 3 Injuries that may require surgical intervention
    - Suspected Fractures or Avulsion Injuries that you are unsure of or unfamiliar with
    - Injuries not responding to conservative care
    - Salter-Harris Fractures or Osteochondral Injuries
    - If otherwise indicated

Prentice, 2009; Starkey, 2013
Musculoskeletal Injuries - Strains

**Signs and Symptoms**
- Vary with the degree of injury (e.g., no loss of motion/strength compared to complete disability)
- Inflammation
- Pain
- Swelling
- Ecchymosis (discoloration/bruising)
- Impaired Function

**Differential Diagnosis**
- Avulsion Injuries
- Muscle Sprains
  - Pain with Active vs. Passive ROM

**Imaging**
- X-Ray to rule out associated bony injury and/or avulsion fractures (if suspected)
  - Injuries to the muscle or tendon will not be visible on plain radiographs
- MRI to identify partial or complete tearing of the muscle or tendon

**Special Tests**
- Joint ROM and Manual Muscle Testing to isolate the involved muscle and determine the extent to which it is injured

**Immediate Management**
- PRICE/POLICE
  - Protect/Rest/Compress
    - Crutches
    - Compression Wraps

**Referral**
- For Athletes, essential to have a supervised and guided rehabilitation program
  - Physical Therapy
  - Athletic Trainer
- Orthopaedics
  - Grade 2 Injuries that you are unsure of or unfamiliar with
  - Grade 3 Injuries that may require surgical intervention
  - Suspected Avulsion Injuries that you are unfamiliar with
  - Injuries not responding to conservative care
  - Heterotopic Ossification
  - If otherwise indicated

**Special Considerations/Complications**
- Heterotopic Bony Formation
  - Ossification within the muscle secondary to trauma and hemorrhaging.

Prentice, 2009; Starkey, 2013
Musculoskeletal Injuries-Fractures

- **Description**
  - Wide range of fractures- stress to open
  - Can represent a relatively simple management process to emergency surgical intervention

- **Clinical Management**
  - History
  - Physical Examination
  - Radiographic Evaluation and Imaging
  - Referral (if necessary)
  - Rehabilitation

*Prentice, 2009; Starkey, 2013*

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Musculoskeletal Injuries-Fractures

- **Physical Examination**
  - Key Findings (not exhaustive)
    - Pain
    - Gross Deformity
    - Crepitation
    - Audible “snap,” “crack” or “pop” at the time of injury (from history)
    - Loss of Function
    - Swelling/Edema
    - Point Tenderness in one specific location
    - Pain with percussion, compression, or stress
    - Pain with extension/dorsiflexion, pronation/supination of wrist (Eyler, 2018)
    - Ottawa Ankle Rules
    - Ottawa Knee Rules
Musculoskeletal Injuries - Fractures

Radiographic Evaluation and Imaging
- X-Rays may be all that are needed
- MRI’s can help identify
  - Associated soft tissue injury
  - Loose bodies within the joint
  - Stress Fractures
  - Chondral Injuries
- CT’s can help
  - Confirm diagnosis
  - Identify fractures involving the joint surface

Management
- Identify the injury
- Refer to orthopedist or other specialist if indicated or if you are unfamiliar with the injury
- Protect
  - Crutches
  - Bracing
  - Splinting
  - Casting

PEARLS for Athletes
- Make sure that you understand the injury, the sport and the rules of the sport.
  - i.e. can the player participate in a cast?
- Athletes may want and/or be able to be more aggressive
- Surgical intervention will not increase the rate of the healing process but it may facilitate an accelerated rehabilitation program
- Strict rest is not a desirable option - work with the athlete and the rehab team to facilitate strengthening, cardiovascular conditioning and other skills that can be maintained in spite of the injury and limitations it may impose.
### Musculoskeletal Injuries in Pediatric Athletes

#### Chronic/Overuse
- Physeal Injuries
- Epiphysis
  - Little League Shoulder
  - Gymnast Wrist
- Apophysis
  - Osgood Schlatter's
  - SLJ
  - Sever’s Disease
  - Little League Elbow
  - Pelvis/Low Back
- Tendonopathies
  - Inflammatory vs. Degenerative
- Fractures
  - Stress
  - Spondylolysis
  - Spondylolisthesis

#### Acute/Traumatic
- Strains
- Sprains
- Fractures
- Contusions

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### Considerations for Overuse Injuries in Pediatric Athletes

#### Risk Factors Associated with Injury
- Age
- Physical Characteristics
- Growth Patterns
- Training Volume
- Previous Injury
- Biomechanics

#### The Impact of Early Sports Specialization...
- Not Necessary (early on)
- Not in the best interest of health. Impacts can be:
  - Physical
  - Social
  - Emotional
- Not Advised
Managing Concussions

“Treat a Concussion, Don’t Grade It”
Ken Locker
Characteristics of Concussions
We now know that…. 

- “Dings,” “bell-ringers” are concussions
  - Significant Brain Injuries

- Concussions do not have to involve LOC
  - 85% - 90% do not

- Young athletes are at increased risk for serious problems (CDC 2012)
  - Less developed shoulder/cervical spine muscles
  - Poor technique
  - Brain is not as developed and less able to withstand the insult associated with a concussive injury

How Do We Manage a Concussion?

Recognition relies on Education

Diagnosis relies on Recognition

Management relies on Diagnosis
Recognition and Diagnosis

• Diagnosis is a clinical decision.

• Evaluation should include:
  - Medical Assessment
    - Comprehensive history
    - Clinical Symptoms
    - Detailed neurological evaluation
      - Mental status
      - Cognitive functioning
      - Sleep/Wake disturbance
      - Ocular function
      - Vestibular Function
      - Gait
      - Balance
  - Determination of clinical status
  - Determination of the need for emergent neuroimaging to exclude a more severe brain injury. (McCrory, 2017)

• When possible and available, compare with baseline performance.
Advanced Imaging

- Not necessary for diagnosis of concussion
- Used to rule out:
  - Skull Fractures
  - Structural Injuries
    - Hematoma
    - Hemorrhage
- Consider for:
  - GCS less than 15
  - Deteriorating Mental Status
  - Focal Neurologic Deficits
  - Abnormal fundoscopic exam/papilledema
  - Progressive Symptoms

(Moffatt, 2017)

Clinical Tools to Help Identify and Concussions

- Clinical Symptoms
  - Graded Symptom Check List
- Neurologic Status
  - Glasgow Coma Scale
  - Cranial Nerve Assessment
- Neurocognitive Deficits
  - SAC
  - Computerized Testing
    - ImPACT
    - ANAM
    - CogSport
    - XLNTBrain
  - Formal Neuropsychological Evaluation
    (not required for all athletes)
- Postural Stability
  - BESS
  - Sway Balance (ios mobile devices)
  - C3 (Cleveland Clinic Concussion System) (I-Pad App)

- SCAT5
  - Clinical utility decreases after 3-5 days
  - SCAT5 (ages 13 and up)
  - Child SCAT5 (ages 5-12)
    - Includes
      - Glasgow Coma Scale
      - Maddocks Score
      - Graded Symptom Evaluation
      - SAC
      - BESS
      - Coordination
- ACE (CDC)
### Symptom Categories

**“What They Tell Us”**

#### Physical Symptoms
- Headache
- Fatigue
- Dizziness
- Sensitivity to Light and/or noise
- Nausea
- Balance Problems

#### Emotional Symptoms
- Irritability
- Sadness
- Feeling more emotional
- Nervousness

#### Cognitive Symptoms
- Difficulty remembering
- Difficulty concentrating
- Feeling slowed down
- Feeling like they are “in a fog”

#### Sleep Symptoms
- Drowsiness
- Sleeping more than usual
- Sleeping less than usual
- Trouble falling asleep

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### Signs of Concussion

**“What We See/Observe”**

- Vacant Stare
- Slow to Answer Questions or Follow Instructions
- Easily Distracted
- Disoriented; can’t focus attention
- Disoriented; unaware of time, date, and place
- Slurred or incoherent speech
- Photophobia

- Memory Deficits (Repeatedly asks the same questions, Can’t remember events prior to injury, can’t remember events after the injury)
- Gross incoordination (can’t walk a straight line)
- Emotions out of proportion to the situation
- Loss of Consciousness
- Seizures
- Nystagmus
Beyond the field of play

- **Personal/Home**
  - Reduced Play/Activity
  - Difficulty completing chores
  - Depression
  - Irritability:
    - Parents
    - Siblings
    - Boyfriends/Girlfriends

- **Academic/School**
  - Concentration/Focus
  - Remembering Assignments
  - Tolerance of Environment
  - Fatigue
  - Drop in Grades, Attendance

Management
Immediate Management Considerations

1. Make sure that they understand the injury.
2. Outline expectations
   a. Yours….
      1. Avoid Re-injury
      2. Communication from them about increases in symptoms.
   b. Theirs…
      1. No sports or activities until cleared and as directed by health care professional
         ✓ Light, non-contact cardiovascular activity is encouraged…IF it does not result in a significant increase in symptoms
      2. How long will they be out?
         ✓ Each injury is different
         ✓ Adults- 10-14 days…approximately
         ✓ Children - 4 weeks…approximately
3. Children
   ✓ Should be in school (see next slide)
4. Return to activity should follow a medically directed gradual increase and return to full activities.

Managing Concussions

- Current cornerstone of concussion management is physical and cognitive rest until acute symptoms resolve.
  ✓ Cognitive rest may ease discomfort during acute stages
  ✓ Minimize brain injury demands following concussion (McCrory, 2017)
- Current evidence regarding the amount of rest is limited and evolving. The exact amount of rest is not yet well defined (Berlin, 2017).
  ✓ Initial rest period of 24-48 hours may be beneficial (McCrory, 2013)
  ✓ Strict rest for 5 days following injury offers no additional benefit over the usual 1-2 day rest. (Thomas 2015)
- Berlin, 2017
  ✓ After brief period of rest, encourage gradual and progressive increase in activities that do not result in an increase in physical or cognitive symptoms.
Risk Factors for Protracted Recovery

- Adults...>10-14 days
- Children...> 4 weeks
- Number 1 predictor of slower recovery is the severity of the person's initial symptoms on the first day, to a few days following injury (McCrorry, 2017)

Pre-Morbid (Pre-Existing)
- Prior History of Concussion
- Migraine
- Diagnosed ADHD/ Learning Disability
- Gender (Female>Male)
- Age- Younger > Older

Post-Injury
- Post Traumatic Migraine
- Dizziness (Immediate)
- Fogginess
- Difficulty Concentrating
- Headache
- Imbalance
- Nausea/Vomiting
- Photo/Phonosensitivity
- Increased Physical/ Cognitive Activity
- Visual Abnormalities

Mucha and Steinhaufel (2014)

Changing the Culture of Concussions

- **Nebraska’s Concussion Awareness Act**
  - Effective Date July 1, 2012
- Contains the three tenets of model legislation
  1. Education- Coaches, Parents and Student Athletes;
  2. Removal from Play- if a concussion is reasonably suspected;
  3. Clearance by a licensed Health Care Provider;
- **PLUS**
  4. Return to Learn Protocol
Prior to the Concussion Awareness Act (and others like it across the country), concussion management and return to play had primarily been:

**Return to Activity** =
- Asymptomatic
- Normal NCT
- Completed RTP

**Return to Play**

Remember….
- In a pediatric patient, not all students are athletes but **ALL ATHLETES ARE STUDENTS.**

**THEREFORE….
- We can’t just focus on athletics we need to include academics.**
Cultural Shift….

Return to Activity=

Return to Learn
- Cognitive Rest
- Physical Rest

Return to Play
- Asymptomatic
- Normal NCT
- Completed RTP Progression
- Normal Balance*
- Normal Vision*

Changing the Culture of Concussion

- **Return to Learn** must precede **Return to Play**.

- We can’t thoroughly treat the athlete unless we first treat the student.
  - ✓ If a student-athlete continues to receive academic adjustments due to the presence of any symptoms, they should still be considered symptomatic and not be allowed to resume physical activity. (McAvoy, April, 2011)
Team Based Return to Learn Models for Student-Athletes

NE Department of Education: Bridging the Gap...

AAP and REAP Team Model

- Advocates the formation of a team to collaborate in caring for the student.
  - Family Team
  - Medical Team
  - School Academic Team
  - School Physical Team

Halstead et al, 2013
McAvoy, 2018

Return to Learn Progression

<table>
<thead>
<tr>
<th>Stage</th>
<th>Objective</th>
<th>Activity</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Daily activities at home that do not give child symptoms</td>
<td>Typical activities of daily living (ie. reading, texting, screen time). Start with 5-15 min. at a time and gradually build up</td>
<td>Gradually return to typical activities</td>
</tr>
<tr>
<td>2</td>
<td>School Activities</td>
<td>Homework, reading, or other cognitive activities outside the classroom</td>
<td>Increase tolerance to cognitive work</td>
</tr>
<tr>
<td>3</td>
<td>Return to School Part-Time</td>
<td>Gradual introduction to schoolwork. May need to attend ½ days, alternating days</td>
<td>Increase academic activities</td>
</tr>
<tr>
<td>4</td>
<td>Return to School Full-Time</td>
<td>Progress activities until a full day can be tolerated</td>
<td>Return to full academic activities and catch up on missed work</td>
</tr>
</tbody>
</table>

## Return to Play Progression

<table>
<thead>
<tr>
<th>Step</th>
<th>Aim</th>
<th>Activity</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Symptom Limited Activity</td>
<td>Daily activities that do not provoke symptoms</td>
<td>Gradual reintroduction of work/school activities</td>
</tr>
<tr>
<td>2</td>
<td>Light Aerobic Exercise</td>
<td>Walking or stationary cycling at a slow to medium pace. No resistance training.</td>
<td>Increase heart rate in a controlled environment</td>
</tr>
<tr>
<td>3</td>
<td>Moderate Aerobic Exercise</td>
<td>Running or agility drills; NO head impact activities.</td>
<td>Add functional movement</td>
</tr>
<tr>
<td>4</td>
<td>Non-contact training drills</td>
<td>Increase intensity of activities; passing drills, re-introduce resistance training.</td>
<td>Exercise, coordination, and increased thinking during activity.</td>
</tr>
<tr>
<td>5</td>
<td>Full Contact Practice</td>
<td>Following Medical Clearance; participate in full activities</td>
<td>Restore confidence and assess functional skills</td>
</tr>
<tr>
<td>6</td>
<td>Return to Sport</td>
<td>Normal Game Play</td>
<td></td>
</tr>
</tbody>
</table>

After all that...When can an Athlete Return to Play?

No academic adjustments/accommodations in place + Resolution of clinical symptoms + resolution of neurocognitive deficits + normal balance/postural stability =

*Begin the Graduated Return to Play Protocol*

**NO SAME DAY RETURN TO PLAY**

In athletes that have been diagnosed with a concussion.

Medical Team Expanded:
The medical professionals involved in the interdisciplinary management of concussion.
Health Care Providers Roles and Functions throughout the Management of Sports Related Concussion

<table>
<thead>
<tr>
<th>Provider</th>
<th>Function</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician</td>
<td>E, SM, RH/T</td>
<td>P, DM, RTLP</td>
</tr>
<tr>
<td>Neuropsychologist</td>
<td>E, RH/T</td>
<td>DM, RTLP</td>
</tr>
<tr>
<td>Psychologist</td>
<td>E, RH/T</td>
<td>DM, RTLP, PCM</td>
</tr>
<tr>
<td>Neuro-Optometrist</td>
<td>E, RH/T</td>
<td>DM, PCM</td>
</tr>
<tr>
<td>Audiologist</td>
<td>E, RH/T</td>
<td>DM, RTLP, PCM</td>
</tr>
<tr>
<td>SLP</td>
<td>E, RH/T</td>
<td>DM, RTLP, PCM</td>
</tr>
<tr>
<td>Occupational Therapist</td>
<td>E, RH/T</td>
<td>DM, RTLP, PCM</td>
</tr>
<tr>
<td>Physical Therapist</td>
<td>E, RH/T</td>
<td>DM, RTLP, PCM</td>
</tr>
</tbody>
</table>

Function: Evaluation (E), Exercise Prescription (EP), Sideline Management (SM), Rehabilitation/Treatment (RH/T), Phases- Prevention (P), Diagnosis and Management (DM), Return to Learn and Play (RTLP), Post Concussion Monitoring (PCM).

Adapted from Pabian et al, 2017, p. 126.
Closing Thoughts

- We know a lot about concussions, but the hurrider-we-go, the behinder-we-get.
- Concerns with concussions:
  - It may not as much be the cause of the injury, but rather the management that we continue to focus our efforts on at this time.
  - 2nd Impact Syndrome
    - Morbidity Rate = 100% (Martineau, 2007)
    - Mortality Rate = 50% (Martineau, 2007)
    - Fortunately, if we can educate and get people to communicate, it is also (almost) completely preventable.
  - CTE and other long-term neurodegenerative diseases
    - "Whether repetitive head impact and multiple concussions sustained in youth lead to long-term neurodegenerative diseases, such as CTE and Alzheimers, remains unclear." (IOM, 2013 pg. 189)

THANK YOU!
References


References

28. NE Department of Education. *Bridging the Gap from Concussion to Classroom*, 2014.
Musculoskeletal Injuries-
Sprains

- Definition
  - Injury to ligaments—non-contractile soft tissue that connects bone to bone
  - Disruption to the integrity of a ligament caused by trauma resulting in tensile and/or shear forces being delivered to a joint
  - Typically 3 degrees of injury
    1. Grade 1—Stretching of the ligament with minimal to no joint instability
    2. Grade 2—Partial tearing of the ligament with moderate joint instability
    3. Grade 3—Complete disruption (rupture) of the ligament with gross joint instability

Prentice, 2009; Starkey, 2013

Musculoskeletal Injuries-
Strains

- Definition
  - Injury to muscles or tendons (contractile tissues that connect muscle to bone)
  - Damage of the muscle or tendon occurs secondary to overstretching or a forced contraction against overwhelming resistance
    - Typically occurs in the muscle at the musculotendinous junction
  - Typically 3 degrees of injury
    1. Grade 1—Stretching of the muscle or tendon; typically full Range of Motion that is comparatively strong but may be painful.
    2. Grade 2—Partial tearing of the muscle or tendon; typically limited Range of Motion that is comparatively weak and painful. May exhibit a divot or defect in the muscle or tendon.
    3. Grade 3—Complete disruption (rupture) of the muscle or tendon; typically significant impairment and dysfunction during attempts to actively contract the muscle.

Prentice, 2009; Starkey, 2013