Age Matters in the Evaluation and Treatment of Concussion, or Does it?
Jason A. Hugentobler PT, DPT, SCS, CSS
Catherine Quatman-Yates PT, PhD
Bara Alsalaheen PT, PhD
Airelle Giordano PT, DPT, OCS, SCS

Course Objectives
At the conclusion of this course, participants will be able to:
• 1. Describe the state of the evidence relative to the evaluation and management of youth with concussion.
• 2. Describe the state of the evidence relative to the evaluation and management of adults with concussion.
• 3. Describe some of the gaps within the literature relative to the evaluation and management of patients with concussions across the lifespan.

Outline
• Overview of the Evidence for Concussion Evaluation – Dr. Quatman-Yates
• Overview of the Evidence for Concussion Interventions – Dr. Alsalaheen
• Case-Based Considerations
  – Adult – Dr. Giordano
  – Youth – Dr. Hugentobler

Outline cont...
• Panel Q&A – 15 minutes
  – Practice evolution
  – Future studies/interests
• Audience Q&A – 15 minutes
  – Difficult cases
  – How to work within a team

Disclosures
• Bara Alsalaheen
• Katie Quatman-Yates
• Airelle O. Giordano
  – Members of the APTA concussion clinical practice guideline (CPG)
• Jason Hugentobler
  – Evidence in Motion Faculty Member for Concussion Certification Program
Age Matters in Concussion Assessments, or Does it?

Catherine Quatman-Yates, PT, DPT, PhD
Cincinnati Children’s Hospital
CSM 2017

Outline

• Historical progression of PT involvement in concussion management
• Status of the evaluation/assessment literature relative to PT needs and uses
• How age may and may not matter for PT evaluation/assessments

Way back when...

Cultural Shifts and Study Boom

Guidelines for Concussion / Mild Traumatic Brain Injury & Persistent Symptoms
Second Edition
PT Assessments: Age matters, or Does it?


Why do we perform PT concussion assessments?

Knowledge Gaps

- Identify Impairments
- Establish goals
- Formulate prognosis
- Generate a plan
- Monitor progress

WHY

HOW

WHAT

WHY

HOW

WHAT

WHY

HOW

WHAT
**WHY**

PTs perform concussion assessments and evaluations, is fundamentally the same regardless of age.

**HOW**

- Identify impairments
- Establish goals
- Formulate prognosis
- Generate a plan
- Monitor progress

**WHAT**

1. **Multi-system approach**
2. **Primary vs multi-source**
3. **Other considerations**

**Why PTs perform concussion assessments and evaluations.**

**Not just a “brain” injury**

- Musculoskeletal system
- Vestibular system
- Oculomotor system
- Sensorimotor processing
- Motor coordination
- Exertional/autonomic adaptation

And these are just the systems, PTs are most directly concerned with...

**Multi-System Approach**

- Also see: Collins et al. A comprehensive, targeted approach to the clinical care of athletes following sport-related concussion. Knee Surg, Sports Trauma, Arthroscopy. 2014.

- Nearly 60% showed signs of impairment in all 4 categories.
- Over 80% showed signs of impairment in 3 out of 4 categories.

### PT Assessments: Age matters, or Does it?

1. Multi-system approach
2. Primary vs multi-source
3. Other considerations

### Other Considerations (How), Regardless of Age

- Duration of exam
- Order of assessments
- Assessment prioritization

Other Age-related Considerations that Influence How to Assess Patients with Concussion:

1. Ability to respond and follow instructions for instructions
2. Veracity of self-report and performance on physical assessments may be more uncertain for younger individuals

![Diagram](image.png)
WHY

1. What measures you use
2. How you interpret results

HOW

WHAT

PT Assessments: Age matters, or Does it?

Symptom Scales

- Post-Concussion Symptom Inventory (PCSI)
  - Self-report form ages 5-7 (13 items)
  - Self-report form ages 8-12 (25 items)
  - Self-report form ages 13-18 (26 items)
  - Parent report form ages 5-18


Vestibular/Oculomotor Assessments


PT Assessments: Age matters, or Does it?

Subjective
- Health and injury history
- General system screens
- Patient-specific goals and needs
- Self-report outcome measures/Quality of Life
- Post-Concussion Symptom Scales

Basic Clinical Exam
- Musculoskeletal Involvement
  - Posture, cervical and scapular ROM, strength, mobility, biomechanics, kinesthetic awareness, TMJ assessment
- Vestibular/Oculomotor
  - Near point convergence distance, smooth pursuits, saccades, spontaneous nystagmus, gaze holding, VOR, VOR cancellation, head thrust, motion sensitivity
  - Vestibular/Oculomotor Screen (VOMS)
  - Dix Hallpike test
- Exertional Testing
  - Treadmill tests (Buffalo and others), stationary bike, other

Functional Assessments
- Balance/Postural Control
- Coordination
- Gait
- Quality of Movement
- Dual Tasking
Balance/Postural Control Assessments

- Conflicting results on the impact of age on common post-concussion balance/postural control
  - Balance Error Scoring System (and modified versions) most commonly studied
    - Learning effects (Valovich, 2003)
    - Developmental effects (Quatman-Yates, 2014)
    - No age, sex, anthropometrics, sports participation associations with BESS (Khanna, 2015)

PT Assessments: Age matters, or Does it?

Additional Assessment Areas of Interest

- Self-management skills and abilities
  - General questions about perceived burden/barriers, confidence, motivation
- Personal coping styles/abilities
  - Brief Cope, Brief Cope Child, Brief Cope Parent (Snell et al., 2011)
  - Revised Life Orientation Test
- Behavioral health
  - Vanderbilt scale
  - NIH Toolbox, PROMIS metrics

PT Assessments: Age matters, or Does it?

Additional Assessment Areas of Interest

- Social factors
  - NIH Tool Box, PROMIS measures
- Family dynamics/parenting styles, etc
  - E.g., Kurowski et al. 2011. Caregiver ratings of long-term executive dysfunction..PM&R.
  - General Function Subscale of McMaster Family Assessment Device (FAD-GF)
  - Parenting Practices Questionnaire (PPQ)

Key Take Home Points

- Keep in mind the “PT Whys”
- Use a multi-system approach, regardless of age
- With younger individuals, a multi-source approach is often necessary, with older individuals a single-source may suffice in many circumstances
- Other age-specific “Hows” include ability to follow instructions and anticipation of veracity of self-reports and performance
- Many evaluation strategies available, no gold standards, some may have age-specific elements
Physical Therapy Interventions for Concussion

Bara Alsalaheen, PT, PhD

Outline
- Neurophysiological cascade & clinical presentation
- Overall recovery as a function of age
- Rest as an intervention
- Physical therapy interventions
  - Cervical Physical Therapy
  - Vestibular Physical Therapy
  - Exertional Physical Therapy
- Other therapies

Neurophysiological cascade

Clinical presentation

Current recovery model

Active & targeted recovery model

This is a preliminary handout. Full handout will be posted on SPTS website on the CSM handout page on the day of the lecture.
Summary of clinical recovery

Absolute rest
Gradual task-oriented exertion

Injury
Time
Relative rest & Targeted rehab

Absolute rest
Gradual task-oriented exertion

Injury
Time
Injury onset
Injury resolution
Relative rest & Targeted rehab

Overall recovery as a function of age

Williams et al., 2015

Days in recovery

Self-reported symptoms
Neurocognitive tests
Outcome measure

Rest as an intervention

• **Group 1: Usual care**
  – Rest 1-2 days

• **Group 2: Strict rest**
  – 5 days of strict rest at home (no school, no work, nor physical activity)

• **Conclusion:**
  – Strict rest longer than 48 hours offered no added benefit
  – Strict rest may have contributed to increased symptoms reporting (Thomas et al., 2015)

Physical therapy Interventions for concussion (status of evidence)

• Safety and feasibility

• Clinical utility and Appropriateness

• Efficacy & effectiveness

Cervicovestibular rehabilitation

• Control arm (n = 14):
  - Non-provocative range of motion exercises, stretching and postural education

• Experimental arm: (n = 15)
  - All above + cervical spine physiotherapy and vestibular rehabilitation

This is a preliminary handout. Full handout will be posted on SPTS website on the CSM handout page on the day of the lecture.
Vestibular rehab

- 114 patients (67 F/47 M)
- Median # days since concussion: 58
- Median number of visits: 4 (2-13)
- Median Duration: 7 days (2-58)

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Pre-treatment</th>
<th>Post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Gait Index (DGI)</td>
<td>20 (3)</td>
<td>23 (1)</td>
</tr>
<tr>
<td>Functional Gait Assessment (FGA)</td>
<td>22 (5)</td>
<td>28 (3)</td>
</tr>
<tr>
<td>Gait Speed</td>
<td>1.02 (1.28)</td>
<td>1.28 (23)</td>
</tr>
<tr>
<td>Timed &quot;Up &amp; Go&quot; TUG (sec)</td>
<td>9.7 (1.8)</td>
<td>8.7 (5)</td>
</tr>
<tr>
<td>Five Times Sit-to-Stand (Sec)</td>
<td>13.1 (6)</td>
<td>9.7 (5)</td>
</tr>
<tr>
<td>Sensory Organization Test (SOT) (Composite)</td>
<td>48 (19)</td>
<td>71 (13)</td>
</tr>
</tbody>
</table>

All measures are statistically significant, P < .01

Alsalaheen et al., JNPT, 2010

Comprehensive PT intervention for overlapping impairment patterns

<table>
<thead>
<tr>
<th>Symptom Classification</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological (P)</td>
<td>24%</td>
</tr>
<tr>
<td>Cervicogenic (C)</td>
<td>12%</td>
</tr>
<tr>
<td>Vestibular/oculomotor (V)</td>
<td>20%</td>
</tr>
<tr>
<td>Mixed, PC</td>
<td>12%</td>
</tr>
<tr>
<td>Mixed, PV</td>
<td>12%</td>
</tr>
<tr>
<td>Mixed, CV</td>
<td>12%</td>
</tr>
<tr>
<td>Mixed, all</td>
<td>8%</td>
</tr>
</tbody>
</table>

No interaction effects based on age (adolescents vs. adults)

Manual Therapy

- Cervical
  - OA traction
  - Occiput dorsal mobilization
  - Lower cervical facet distraction
  - Lower cervical facet glide

- Thoracic
  - Bilateral Facet Distraction

Soft tissue mobilization

- Suboccipitals
- Cervical Paraspinals
- Upper Trapezius
- Levator
- Scalenes

Strengthening

- Modified Cervical Isometrics
- Posterior Cervical Head Slides
- Molar Isometrics
- Stabilizer Biofeedback

This is a preliminary handout. Full handout will be posted on SPTS website on the CSM handout page on the day of the lecture.
Proprioception, postural and scapular training

Cervical Proprioception/Autokinetic Awareness Training

Scapular Training
- Levator and Upper Trap
- Serratus
- Rhomboids
- Lower Trap

Overview of vestibular interventions

Vestibular Interventions
- Eye-Head Coord/Gaze stability
- Postural stability
- CRM (If indicated)
- Convergence and accommodative function
- Visual-perceptual training

Eye-Head coord/Gaze stability

- Vorx1
- VORx2
- VOR cancellation
- Saccades
- Smooth pursuit

Convergence

- Pencil push up
- Wall push up
- Near/far Target
- Hart chart

Exercise progression example

Postural stability exercises

This is a preliminary handout. Full handout will be posted on SPTS website on the CSM handout page on the day of the lecture.
Considerations for children

Age-appropriate instructions, demonstrations. Concrete examples on effects of impairments on school activities and other activities (e.g., TV) Exercise prescription & progression parameters

Exertional Physical Therapy

Physiological approach (HR)

Symptom and impairment guided approach

Movement quality, optimal performance

Function

Movement quality & Optimal performance

Symptom and impairment guided approach

Physiological approach (HR)

Hockey Player Stage I

• Limited:
  ✓ Head movement
  ✓ Impact
  ✓ External weights
  ✓ Noise (done in a quiet area)
  ✓ Position change
  ✓ Dual task

Hockey Player Stage II

• Add head movement
• Add positional changes using different equipment
• Introduce busier environments
• Add low level dual tasks (counting repetitions)

This is a preliminary handout. Full handout will be posted on SPTS website on the CSM handout page on the day of the lecture.
Hockey Player Stage IIIA
- Add more aggressive intensity (e.g., add resistance)
- Add higher body impact activities
- Add concentration challenges (count backwards by 7)
- Strength, conditioning, coordination

Hockey Player Stage IIIB
- Maximum sport-specific exertion
- Avoiding contact

Hockey Player Stage IV
- Sport-specific drills
  - Full impact
  - Full contact

Other interventions
- Vision Therapy
- Medical Management
- Cognitive Behavioral Therapy
- Speech Therapy
- Strength and Conditioning
- Athletic Training

This is a preliminary handout. Full handout will be posted on SPTS website on the CSM handout page on the day of the lecture.
Adult Concussion Case Example

Airelle O. Giordano, PT, DPT, OCS, SCS

Initial injury

• One month post concussion
  – Produce manager
    • Ran after person stealing
    • Car door hit head, fell, hit his head again
  – Demands of job: lifting, walking
  – Goals:
    • Return to work
    • Return to competitive bowling, gym program
    • Play with grandchild

History

• Medications: Tylenol, Amantadine, Amitriptyline, Melatonin, Lunesta, Cymbalta, Vivance
• No imaging at ED
• No previous baseline testing

• Previous History:
  – No previous concussions, history or migraines, learning disabilities or motion sickness

Post Concussion Symptom Checklist

• Headaches: Y
• Dizziness: Y
• Sensitivity to light/Sound: Y and Y
• Concentration difficulty: Y
• Memory Changes: Y recent memory challenges
• Emotional dysregulation/lability: Y
• Depression: feeling down
• Fatigue: Y
• Insomnia: Y
• Reduced Alcohol Tolerance: No drinking currently

Main Complaints

• Headaches
• Dizziness
• Insomnia

Objective Questionnaires

• HDI: 64 (severe)
  » Jacobson et al., 1994
• NDI: 58
  » Dubs et al., 2008
• ABC: 32% (risk for fall)
  » Miller et al., 2000
• DHIS: 84 (severe handicap)
  » Jacobson et al., 1988
• Depression screen: 3/6
Memory and Exertion

- Vitals:
  - BP: 140/86
  - HR: 75
- Immediate recall: -
- Delayed recall (3 min): +
- Working memory: 6/7

- Bike:
  - HA 2/10 with 3 min on level 1 of bike
  - Able to assess treadmill on 7th visit
    - Initial: HA 6/10, Dizziness, 4/10, HR 88 bpm
    - After 2 min: HA 7/10, Dizziness 7/10, HR 107 bpm

Vestibular & Oculomotor Screen

- King Devick: 1min 34sec
- Near Point Convergence: 5 inches
- Dix Hallpike: -B

- Spontaneous nystagmus
- Saccades
- Smooth Pursuit
- Gaze holding
- VOR
- VOR cancellation
- Head thrust
+ Motion Sensitivity

Cervical Exam

- A/PROM: All equal and normal
- Joint mobility: normal C2-C7
- Palpation: - paraspinals, -sub-occipitals, - facial mms but STM to Frontalis decreased HA but it came right back
- Joint position error: ?
- No pain created with exam
- Neck flexor endurance: 26 sec

Balance

- BESS test:
  - 1) firm surface; double leg stance: 0
  - 2) firm surface; SLS (non-dominant): 8
  - 3) firm surface; tandem stance: 2
  - 4) foam surface; double leg stance: 0
  - 5) foam surface; SLS (non-dominant): 10
  - 6) foam surface; tandem stance: 10
- Total # Errors (max. 60): 30

Initial Treatment

- Sleep Hygiene
- Walking program:
  - Stair training 1-3 flights at a time multiple times a day
  - Walk to and from mailbox
  - Walk at the mall
- Increase housework
- Convergence and Saccades training
- Sensory Motor Training

Month 1

- Headache
- Dizziness
- Activity
Treatment 4-6 months

- Motion Sensitivity: videos at home
  - Increase to more than 30 sec
  - Walk into the grocery store
  - Motion Sensitivity Quotient
    - Aiken et al., 2003
- Get out of the house
  - Bowling
  - Walk at an outdoor park

@ 6 months.......

- Daughter went into labor
- Anxiety and Depression
- Needs to work
- Fell and twisted knee
- Complaining of short term memory issues
- Botox put on hold

Treatment 6-8 months

- Psychologist
- Speak with wife regarding memory and progressions
  - Speech referral
- Given a pedometer for step counts
  - More accountable at home

Education and Self Management

- To both WIFE and PATIENT
  - Hold patient accountable
  - Hold wife accountable
  - Make lists, put by door
  - Carry pen and pad at all times
  - COMMUNICATION
  - Stick to schedules

Outcome surveys at DC

Follow up at 1 year

- Continuing with HEP
- Full time job with benefits
- Bowling competitively and gym program
- Thankful for his life back!
Adolescent Concussion Case Example

Jason A. Hugentobler, PT, DPT, SCS, CSCS
Cincinnati Children’s Hospital Medical Center

Subjective Examination

• Mom and Dad Present
• One month post concussion
  – 10 yo male, 5th grader
  – Injured in MVC – whiplash injury and hit back of head on sister’s car seat
  – Back to full days of school
    • Still some extra time for homework
  – Loves to play football, soccer, wrestling, basketball, indoor soccer, swimming, tennis and baseball
    • Can't participate in "ANYTHING"

Different perspectives

History

• Medications: Melatonin, Tylenol, Adderal XR
• Imaging at ED – negative
  – Spent 2 weeks in soft collar as precaution due to posterior head/neck tenderness
• ADHD
• B student
• Video games

Post Concussion Symptom Inventory - Child

Headaches*** - worse in morning
Dizziness
Difficulty Concentrating
Difficulty Remembering
More tired
Sad
Neck Pain
Head pain***
**Post Concussion Symptom Inventory - Parent**

- Both parents
- All symptoms rated at least a 1
  - No 6’s!
- Pre-injury ratings highlight ADHD
  - Dad notes the clumsy movements
- Both parents report concerns about his mood
  - Didn’t attend a friends birthday party for fear of worsening his symptoms

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**PCSII Initial**

![Graph showing PCSI Initial scores](image)

**Main Complaints**

Child
1. Headaches
2. Dizziness
3. Difficulty getting to sleep

Parents
1. Headaches
2. Mood
3. Insomnia

- Depression based on subjective reports?

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**Vanderbilt**

47 item questionnaire (teacher, parent, caregiver)

- ADHD – predominantly inattentive type
- ADHD – predominantly hyperactive
- ADHD – combined
- Oppositional defiant disorder screen
- Conduct disorder screen
- Anxiety/depression screen
Objective Measures

- PedsQL: 50
- NDI: 60
- Vitals
  - BP: 110/60
  - HR: 90
- Cervical Exam
  - + headache increase with pressure to SO area
  - DNF Endurance: 5 seconds and ↑ HA
  - ROM WFL but “tight”

Objective Measures cont...

- VOMS
  - NPC + and 20 cm
  - VOR + vertical
- BESS: 25
- Aerobic Assessment
  - 8 minutes before ↑ in HA
  - Done at Pictorial Children’s Effort Rating Table level 4
  - Bike

Effort Scales

PCERT

Initial Treatment Plan

- Posture education
- Neck stretching
- Chin tucks
- Scap sets
- Aerobic Activity

Strength

- Follow stepwise progression
  - Light resistance initially
- Set parameters
  - Sets, reps, resistance, rest times
- If asymptomatic during ex → progress
  - Need to account for cumulative effect of exercise
- Collins et al 2014 → 6600 HS athletes
  - Concussed vs uninjured
    - Smaller mean neck circumference
    - Small mean overall neck strength
Kid + Ball + Trampoline = 3 months

- Main complaint
  - Low grade headache worsened with activity
  - Started on meds
- Met most goals for PT
  - Still unable to get past 15 cm for NPC
- Goal → get ready for tennis and spring soccer?
  - Return to learn before return to play

Exertion progression

- Initial plan
  - Low level agility (agility ladder, line)
    - 5 seconds: 30 seconds at BORG 11-15
    - Remain asymptomatic → re-assess vitals/PCS5
- Progression
  - Agility ladder → complexity of patterns (dual task)
    1. Same ratio w/ higher intensity
    2. Change ratio (10:20) at same intensity
- Sport Specific
  - 5-10 second bursts (Borg 16-18)
  - 30 second rest
**Education and Self Management**

- **SPOILER ALERT**

**Key Points**

- Differences in the *interventions*?
  - Related to work
  - Related to school
  - Age-appropriate activities

**Key points**

- Keep exercises simple
- Communication Style/Language
- Number of learners
- Coping mechanisms
- Support system
- Resources

**Thanks**