Clinical Profile and Active Treatment Approach to Concussion Management

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Disclosure Statement

Micky Collins, PhD is a Co-Founder and Stakeholder of ImPACT Applications, a computerized neurocognitive test battery designed to assess sports concussion and Mild Traumatic Brain Injury.
Objectives

1. Conceptualize concussion as a heterogeneous entity.
2. Discuss assessment findings that help establish targeted clinical profiles for concussion.
3. Discuss how clinical management, treatment and rehabilitative directives are dictated by these clinical profiles.
Concussion: A Heterogeneous Injury

- Patients present with different preexisting risk factors, have different psychological characteristics and experience different injury biomechanics.

- Symptom presentations are also variable across cognitive, physical, mood and sleep domains.

- Concussion is a complex neurological injury and a uniform “cookbook” approach to management and treatment is not effective.
UPMC Concussion Program - Clinical Assessment Approach

- Neuro-cognitive
- Vestibular
- Physical Exertion
- Ocular-Motor
- Symptoms
- Concussion

UPMC Concussion Program
In-Office Evaluation

❖ Clinical Interview
❖ Computerized Neurocognitive Testing
❖ Vestibular-Ocular Screening
In-Office Evaluation

❖ Clinical Interview
❖ Computerized Neurocognitive Testing
❖ Vestibular-Ocular Screening
Computer-Based Neurocognitive Testing

Several tests on the market...
- Cogsport (Axon)
- Headminders (CRI)
- ANAM
- CNS Vital Signs
- C3Logix
- ImPACT

Immediate Post-Concussion Assessment and Cognitive Testing - ImPACT

- ImPACT and ImPACT Pediatric are the only FDA-approved concussion assessment tools
  - Over 250 Peer-Reviewed Publications on Validity, Reliability, Sensitivity/Specificity, etc.
Concussion Evaluation Timeline -
Computerized Neurocognitive Testing and Clinical Evaluation

Pre-season

Baseline testing
Supervised by ATC, PT Physician, or Clinic

Concussion
-Sideline Evaluation

1-3 Days
First follow-Up
Specialty Clinic Evaluation -Clinical management decisions determined

Follow-up Evaluation as needed
Return to play
In-Office Evaluation

❖ Clinical Interview
❖ Computerized Neurocognitive Testing
❖ Vestibular-Ocular Screening
Why Assess the Vestibular-Ocular Systems?

Subjective Complaints of Dysfunction

- **Dizziness**, **Fogginess**, Feeling “one step behind/detached”, Fatigue
- Motion discomfort, Nausea
- Environmental sensitivity, Difficulties with sensory integration
- Anxiety/Irritability
- Impaired balance
- Headache, Difficulty focusing, Blurred vision, Difficulty with Math/Reading

*Predicts protracted recovery from sports-mTBI
Lau, Collins et al, *AJSM* 2009
Lau, Collins et al, *AJSM* 2011
VOMS:
Vestibular and Oculo-Motor Screening Examination

- A brief 5 minute clinical screening tool to identify additional vestibular and ocular motor dysfunction and symptoms following concussion
- Used in conjunction with symptom reporting, neurocognitive assessment, cervical and exertion screening
- VOMS symptom scores >2 and NPC distance >5cm represent clinically useful cut-offs

*Mucha, Collins et al, 2014. AJSM*
The Diagnostic Accuracy of the VOMS (adj. for age) for Predicting Concussed Patients is Excellent (.90 [95% CI= .86-.95], \( p < .001 \)).

VOMS Items=.90

Receiver Operating Characteristic Curve

Dotted line=.50 or no better than chance

Positive Prediction Rate of 90%

* Model variables: ln(age), VOR, VMS and NPC distance, dotted line indicates AUC = 0.50
Clinical Evaluation and Assessment

✓ Detailed Clinical Interview
✓ Vestibular-Ocular Screening
  (and more extensive evaluation if indicated)
✓ Computerized Neurocognitive Testing
  (and more extensive testing if indicated)
✓ Exertion Evaluation
  (cardio and dynamic movement)

- Establish diagnosis and prognosis
- **Establish clinical and treatment profiles**
- Establish treatment and rehabilitation plan
  - Academic considerations
  - Exertion level (type, duration, intensity)
  - Specific rehabilitative and treatment plan
- Return to play expectation and plan
Concussion Clinical Trajectories: A Model for Understanding Assessment, Treatment and Rehabilitation

Clinical Profiles Determined by:
- Clinical Interview and Symptoms
- Vestibular-Ocular Testing
- Neurocognitive Testing
- Exertional Testing

Concussion

- Vestibular
- Ocular
- Cognitive/Fatigue
- Cervical
- Anxiety/Mood
- Post-Traumatic Migraine

Growing Empirical Support

- Scherer & Schubert, 2009
  - Alsalaheen, et al, 2010

- Treleaven, et al, 1994
  - Schneider, et al, 2014

  - Mainwaring, et al, 2004
  - Hutchison, et al, 2009
  - Kontos et al., 2012

- Mihalik, et al, 2005
  - Kontos, et al, 2013

- Kontos, et al, 2012

- Heitger, et al, 2009
  - Ellis, et al, 2015
  - Pearce, et al, 2015
Targeted and Active Treatments for Concussion

- Medication
- Exercise
- CBT
- Psychotherapy

- Manual Therapy
- Exercise
- Injection
- Acupuncture
- Biofeedback
- Medication
- Surgery

- Vestibular Rehabilitation
  - Exercise

- Vision Therapy/
  - Orthoptics

- Structured Rest
  - Exercise
  - Medication

- Behavioral Regulation
  - Exercise
  - Medication
  - CBT
  - Education/Trigger Modification

Concussion

- Anxiety/
  - Mood

- Ocular

- Cervical

- Post-
  - Traumatic Migraine

- Cognitive/
  - Fatigue
Concussion Magnifies Pre-existing Issues

- ADHD
- Migraine
- Depression
- Motion sickness
- Sleep problems
- Learning disability
- Vision Problems
- Anxiety
PRE-EXISTING RISK FACTORS FOR EACH CLINICAL PROFILE

**Vestibular**
- Personal or Family History of Motion Sensitivity
  - (Sufrinko et al, CJSM 2016)

**Ocular**
- Personal or Family History of Strabismus, Nystagmus or Lazy Eye (Amblyopia)
  - Pearce et al, AJSM, 2015

**Cognitive/Fatigue**
- History of Learning Disability
  - (Collins et al, JAMA 1999)

**Post-Traumatic Migraine**
- Personal or Family History of Migraine
  - (Kontos et al, AJSM 2014)

**Anxiety/Mood**
- Personal or Family History of Anxiety or Mood-Related Symptoms
  - (Kontos et al, AJSM 2012)
“95% of Concussion Cases Recovery within 7-10 Days” Concussion in Sport Group 2011

FACT or REALITY??
Re-examination of Recovery Curves following Sport-related Concussion

Recovery lasts up to 3-4 weeks for Symptoms...

* \( p < 0.05 \)

**N=66**

High School and College Athletes

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*Henry L, Elbin RJ, Collins MW, Marchetti G, Kontos AP. Neurosurg, 2016*
...3-4 weeks for Memory...

* $p < .05$

**ImPACT Verbal Memory**

**ImPACT Visual Memory**

$N=66$

...and 3 weeks for vestibular and oculomotor recovery.

Consequences of Not Being Removed from Play
40% of concussions are unreported or undetected\(^1\)

44% of young athletes continue to play in spite of having symptoms\(^2\)

1- McCrea et al., 2004  
2- O’Kane et al., 2014
If athletes continue to play following a concussion does that really make things worse?

Study Overview

- 69 athletes with a diagnosed concussion:
  - 35 = REMOVED FROM PLAY
    - Immediately removed
  - 34 = CONTINUED TO PLAY
    - Average of 24.61 (± 28.33) min

- Representation of collision sports (e.g., football, ice hockey, soccer, wrestling, rugby) was similar between REMOVED (45%, 31/69) and PLAYED groups (41%, 28/69) ($p = .46$)

- Athletes completed neurocognitive testing (ImPACT) and symptom reports at 1-7 and 8-30 days; also collected recovery time data

Continuing to Play
**DOUBLED** Recovery Time

<table>
<thead>
<tr>
<th></th>
<th>REMOVED</th>
<th>PLAYED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( (n = 32) )</td>
<td>( (n = 30) )</td>
</tr>
<tr>
<td>DOI to Medical</td>
<td>( 21.97 \pm 18.68 ) Days</td>
<td>( 44.37 \pm 36.03 ) Days</td>
</tr>
<tr>
<td>Clearance*</td>
<td>Range: 8 – 88</td>
<td>Range: 10 - 164</td>
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*\( p = .001 \)

Athletes that continued to PLAY with a concussion were **8.8 times** more likely to have protracted recovery \( \geq 21 \) days (\( \chi^2 = 14.86, p < .001 \))

Does it Matter How Long You Continue to Play?

N = 60; p < .05

Removed immediately: 18.9 days
3-15 minutes: 28.4 days
>15 minutes: 44.1 days

Recovery Time

The UPMC Sports Medicine Concussion Program
Department of Orthopaedic Surgery
Over 15 years treating concussion
UPMC Sports Medicine Concussion Program

Primary Care Practices

Athletic Trainers

Emergency Departments

Complicated Out of Region Referrals

-6 Clinics Across Pittsburgh
-35 Faculty and Staff
-Over 20,000 annual patient visits
-25% of Patients Out of Region

UPMC Concussion Program (Neuropsych)

Primary Care Sports Med
PM&R
Vestibular/Exertion Physical Therapy
Neuro Radiology
Orthopaedic Neurosurgery
Behavioral Neuro-Optometry
Using Concussion Clinical Trajectories to Inform Targeted Treatment Pathways

Risk Factors → Concussion → Assessment of Concussion Clinical Trajectories → Treatment and Rehab Pathways

- Previous Concussions
- Migraine
- LD/ADHD
- Female Gender
- Age
- Motion sensitivity, Ocular Hx?

Collins MW et al, KSST, 2014
TEAM Approach to Treating Concussion

Meeting held in Pittsburgh, October 15-16, 2015
Invited Guests and Non-Voting Participants

37 Invited Experts and representatives from......

Sporting Organizations-
- NFL
- Major League Baseball
- National Hockey League
- USA Soccer
- USA Rugby
- NCAA

Military Organizations-
- DOD
- US Army
- US Navy
- Dept and Veterans
- Brain Injury Center

Public Health-
- Centers for Disease Control
- National Institute of Health
- One Mind

Targeted Evaluation & Active Management (TEAM) Approach to Treating Concussion
“Concussions are characterized by diverse symptoms and impairments in function resulting in different clinical profiles and recovery trajectories.”

“Thorough multi-domain assessment is warranted to properly evaluate the clinical profiles of concussion.”

“Matching targeted and active treatments to clinical profiles may improve recovery trajectories following concussion.”

“Concussion is treatable.”

Collins, Kontos, Okonkwo et al, 2016. Neurosurgery
Keys to Clinical Management of Sports Concussion: What are we Learning?

✓ Recognize the injury, remove from play, and refer to a specialty clinic.
✓ Clinical profiles are the road map and multidisciplinary teamwork is key.
✓ Know your tools, know your patient, and know how it all fits together.
✓ The secret sauce: The right amount of activity, behavioral regulation and matching the right treatment to the right problem.
✓ It is about process NOT protocol.
✓ Concussion is TREATABLE!
UPMC Sports Concussion Program
Referral Number 412-432-3681
Ages 5 and over
Sites at Sports Medicine (Southside), Lemieux (Cranberry), Pine Township, South Fayette (Children’s), Monroeville, Bethel Park, Oakland

Thank you