The Role and Implementation of Safe Exercise in Sport-Related Concussion Management

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Objectives

At the conclusion of this presentation, you will be able to:

▪ Summarize the current best scientific evidence on the benefits of incorporating exercise into concussion management

▪ Identify evidence-based resources/protocols that can be used to safely engage patients in exercise during the subacute phase of concussion recovery

▪ Apply the concepts presented to further develop, adapt, or strengthen your clinical approach to concussion management

***No conflicts of interest to declare.***
Prognosis:
Using Science to Make Confident Decisions

Function %

<table>
<thead>
<tr>
<th>Pre-injury Health Status</th>
<th>Acute Injury</th>
<th>1 Day</th>
<th>1 Week</th>
<th>1 Month</th>
<th>6 Months</th>
<th>1 Year</th>
<th>10 Years</th>
</tr>
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</table>
History of Rest

Expert consensus held that the best treatment during the immediate and early recovery period after concussion is complete rest from physical and cognitive exertion. (McCrory et al., 2013)

– Excessive activity soon after concussion prolonged recovery in animals and humans (Griesbach et al., 2004; Majerske et al., 2008)

– Vulnerable period when the brain is susceptible to reinjury and/or worsening symptoms with cognitive or physical stress. (Giza & Hovda, 2001)

**DO NO HARM = DO NOTHING**
Disturbance of cognition

Vestibular
Psychological
Ocular
Cervical
Cognitive
Post-Traumatic Migraine

Physiological Changes

UPMC
The Beginning

Examined the role of postinjury activity level on post-concussion symptoms and neurocognitive performance

95 concussed adolescent student-athletes seen in a University-based sports concussion clinic

Retrospective assessment of activity intensity scale outcomes at reassessment timepoints

**Important Clinical Finding:**

Subjects who engaged in moderate physical activity performed the best on neurocognitive tests and reported the lowest symptom scores.
Conclusion of Literature Review:

Complete rest exceeding 3 days is probably not helpful, gradual resumption of preinjury activities should begin as soon as tolerated (with the exception of activities that have a high MTBI exposure risk), and supervised exercise may benefit patients with persistent symptoms.
A physical-exertion progression should begin only after the concussed athlete demonstrates a normal clinical examination, the resolution of concussion-related symptoms, and a return to preinjury scores on tests of motor control and neurocognitive function.

Evidence-based practice?
The Effect of Physical Exercise After a Concussion

A Systematic Review and Meta-analysis

Avtar Lal,† MD, PhD, Stephanie A. Kolakowsky-Hayner,† PhD, Jamshid Ghajar,†† MD, PhD, and Maya Balamane,†† MPH
Investigation performed at the Brain Trauma Foundation, Campbell, California, USA

The American Journal of Sports Medicine
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To determine the role of physical exercise on multiple outcomes in patients with concussions, including symptoms, neurocognitive function, and balance.

Population: Patients diagnosed with a concussion of mTBI
Intervention: Physical exercise
Comparison: No physical exercise, physical rest
Outcomes: PCSS, symptom duration, ImPACT, BESS, time loss from work/sport participation
Study Design: RCTs, cohort studies, case control studies, pre-post studies

Searched 5 databases for articles available prior to September 30, 2016.
Figure 2. Effect of exercise on the Post-Concussion Symptom Scale (PCSS) score.
Figure 3. Effect of exercise on change in the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) score.
Important Clinical Conclusions:

• Clear benefits of physical exercise in decreasing the PCSS score, percentage of patients with symptoms of a concussion, and duration of symptoms of a concussion as well as improving reaction time.

• Physical exercise did not have an effect on balance or neurocognitive function.
“After a brief period of rest during the acute phase (24–48 hours) after injury, patients can be encouraged to become gradually and progressively more active while staying below their cognitive and physical symptom-exacerbation thresholds (ie, activity level should not bring on or worsen their symptoms).”
Is early controlled exercise following a concussion safe?

YES!
Clinical Question: Does early controlled aerobic exercise following concussion improve recovery outcomes compared to usual care or delayed exercise?

Main Findings:
- Exercise significantly positively impacted symptom recovery in some studies (Leddy et al., 2019; Micay et al., 2018; Lawrence et al., 2018), but not in others (Lennon et al., 2018; Maerlender et al., 2015).
- Implementing early controlled aerobic exercise did not have a detrimental effect on recovery (Leddy et al., 2019; Micay et al., 2018; Lennon et al., 2018; Lawrence et al., 2018; Maerlender et al., 2015).

CLINICAL BOTTOM LINE

Early controlled aerobic exercise is safe following a concussion, but may not always result in a decrease in symptom intensity and duration.

Exercise may help to improve the psychological state of a concussed patient.
Negative Psychological Response: Depression

- Post-concussion depressive symptoms were identified in 22% of adolescent patients. (Stazyk et al., 2017)

- Concussed athletes exhibit significantly higher levels of depression at 2, 7, and 14 days post-injury compared to baseline. (Kontos et al., 2012)

- At 4-days post-injury, concussed college athletes had elevated depression scores 3x higher than baseline scores. (Mainwaring et al., 2010)

- Increased symptoms of depression in the first week following concussion that gradually decreased over 1-month in NCAA student-athletes. (Roiger et al., 2015)
Negative Psychological Response: Anxiety

- 1/3 of concussed collegiate athletes experienced state anxiety following SRC.  
  (Yang et al., 2015)

- The acute presentation of anxiety symptoms predicted long-term post-concussive issues in mTBI patients.  
  (Dischinger et al., 2009)

- At 6-months post-injury, children with mTBIs were 4.3 times more likely to have a new-onset anxiety disorder diagnosis compared with orthopaedically injured controls.  
  (Luis & Mittenberg, 2002)
Physical Activity > No Physical Activity

In general, being sedentary after an injury or illness is one of the most consistent risk factors for chronic disability. (McLean & Clauw, 2004)

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<tr>
<th>Exercise Benefits</th>
<th>Psychological</th>
<th>Physiological</th>
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<tbody>
<tr>
<td></td>
<td>• Evidence-based treatment for mental health conditions</td>
<td>• Increases neuroplasticity</td>
</tr>
<tr>
<td></td>
<td>• Reduces stress</td>
<td>• Increases blood flow</td>
</tr>
<tr>
<td></td>
<td>• Improves mood</td>
<td>• Releases endorphins</td>
</tr>
<tr>
<td></td>
<td>• Increases feelings of energy</td>
<td>• Increases O2 consumption</td>
</tr>
<tr>
<td></td>
<td>• Enhances sleep quality</td>
<td>• Reduces muscle tension</td>
</tr>
<tr>
<td></td>
<td>• Increases self-confidence</td>
<td>• Normalizes autonomic regulation</td>
</tr>
<tr>
<td></td>
<td>• Increases self-compassion</td>
<td>• Increases cognitive function</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prevents of cognitive decline</td>
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Most early exercise interventions are occurring in sports medicine research labs or clinics.

- Challenging for parents to bring their child every day to complete the exercise and there are barriers to at-home implementation.

- Lack of access to sports medicine healthcare clinics in rural and low socioeconomic areas.

Athletic trainers have daily interactions with their patients.

- Currently no recommendations for athletic trainers on how to implement early physical activity in a safe and standardized manner in the secondary school setting!
Barriers for Implementation

- Time
- Resources
- Competence
- Organizational
Are there standardized, sub-symptom exercise protocols that have been scientifically developed for use during the early phases of concussion management?

YES!
Buffalo Concussion Treadmill Test

The purpose of the BCTT or BCBT is to establish sub-symptom heart rate max.

- Equipment: Symptom assessment, HR monitor, RPE scale, treadmill/stationary bike

- Procedure: To be completed following 24-48 hours of complete rest.
  - Pre-test symptom assessment
  - Begin with speed between 3.3-3.6 mph at 0% incline
  - Increase incline by 1% every minute while maintaining speed
  - Each minute, assess RPE and ask whether there are any symptom changes
  - Test is terminated when RPE ≥17 or ≥3 point increase in symptom severity score
  - Sub-symptom HR max = HR at BCTT/BCBT termination

(Leddy et al., 2011; Leddy et al., 2018; Leddy et al., 2019; Haider et al., 2019)
Then what?

- Concussed patients complete a symptom assessment and then engage in low-level aerobic exercise each day at a prescribed target heart rate (HR) while wearing a heart rate monitor.
  - Stationary bike, treadmill, elliptical, light jog in a safe environment

- The prescribed target heart rate is 80% of the sub-symptom HR max established by the BCTT/BCBT

- Instruct patients to stop the exercise session if their symptoms increase by ≥2 from their pre-exercise symptoms or after 20 minutes.

- Establish a new target HR using the BCTT/BCBT every 7 days for as long as the patient remains symptomatic.
How does it fit with a RTP stepwise progression?

When the patient can complete 20-minutes of the BCTT/BCBT and remain asymptomatic, they can progress to stage 3 of the RTP protocol.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Graduated return-to-sport (RTS) strategy</th>
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<tbody>
<tr>
<td>Stage</td>
<td>Aim</td>
</tr>
<tr>
<td>1</td>
<td>Symptom-limited activity</td>
</tr>
<tr>
<td>2</td>
<td>Light aerobic exercise</td>
</tr>
<tr>
<td>3</td>
<td>Sport-specific exercise</td>
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<tr>
<td>4</td>
<td>Non-contact training drills</td>
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<tr>
<td>5</td>
<td>Full contact practice</td>
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<tr>
<td>6</td>
<td>Return to sport</td>
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Take Home Points

1. Rest may not be best.

2. Low-levels of symptom-controlled physical activity has been proven to be safe during the early phases of concussion management.

3. Exercise may have a positive influence on symptom recovery, but it could be even more important for the psychological care of the injury.

4. There are evidence-based, standardized procedures for post-concussion, sub-symptom exercise prescription that could be implemented by an athletic trainer in collaboration with a sports medicine physician.
THANK YOU!

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References


References


References


