Concussion Recovery from Acute to Return to Play: What the Research Shows & Clinical Implications

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Disclaimer

- I have no financial affiliations to disclose.
- I will not discuss any off-label products or devices.
- I have no conflicts of interest to disclose.

Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016

Rest
- Most consensus and agreement statements for managing SRC recommend that athletes rest until they become asymptomatic and return to baseline before returning to play.

Symptoms
- Most symptoms resolve spontaneously and do not require treatment. However, some symptoms may persist, and it is important to monitor for any new or worsening symptoms.

Physical activity
- Physical activity should be increased gradually and monitored for any new or worsening symptoms.

Cognitive activity
- Cognitive activity should be increased gradually and monitored for any new or worsening symptoms.

Sleep
- Sleep should be maintained as much as possible, and any new or worsening symptoms should be monitored.

McCrory et al., 2017
Post-Concussion Balance Impairments

**BESS**

- **Procedure**
  - 3 stances (firm, foam)
    - Double leg
    - Single leg (non-dominant)
    - Tandem (non-dominant in back)
  - 20 second holds
  - Count the number of errors

- **Errors**
  - Opening eyes
  - Removing hands from the iliac crest
  - Stepping or falling out of position
  - >30 degrees of hip abduction or flexion
  - Lifting the forefoot or heel
  - Remaining out of position > 5 seconds

(Riemann et al., 1999, Bell et al., 2011)

**BESS Limitations**

- Low reliability
  - Finnoff et al., 2009
- Low sensitivity
  - McCrea et al., 2003, Oldham et al., 2018
- High MDC scores
  - Finnoff et al., 2009
- Practice effect
  - Valovich McLeod et al., 2003; Burk et al., 2013

Table 6: Sensitivity (Se) and specificity (Sp) for detecting impairment at postinjury time points

<table>
<thead>
<tr>
<th>Time of injury</th>
<th>Progasse</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 5</th>
<th>Day 7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Se</td>
<td>Sp</td>
<td>Se</td>
<td>Sp</td>
<td>Se</td>
<td>Sp</td>
</tr>
<tr>
<td>GSC</td>
<td>85</td>
<td>100</td>
<td>74</td>
<td>100</td>
<td>55</td>
<td>100</td>
</tr>
<tr>
<td>HESS</td>
<td>85</td>
<td>89</td>
<td>88</td>
<td>96</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>SLC</td>
<td>85</td>
<td>89</td>
<td>89</td>
<td>96</td>
<td>96</td>
<td>96</td>
</tr>
</tbody>
</table>

(McCrea et al., 2003)
Post-Concussion Gait Assessment

- **Conservative gait strategy**
  - Impairments persist up to **two months post-injury** (Howell et al., 2015)
  - Transitional movements (Buckley et al., 2013; Oldham et al., 2016; Buckley et al., 2017)
  - Concussion history (Martini et al., 2011; Buckley et al., 2016; Howell et al., 2016)

What is Tandem Gait?

- 3-meter line

- Clinically feasible assessment across athletic settings
  - Association between dual-task tandem and dual-task gait speed (Howell et al., 2017)

- <75% of HS athletes were unable to meet the 14 second cutoff (Santo et al., 2017)

Tandem Gait vs BESS
Clinical Implications

• Tandem gait > BESS (acutely)

• Neither are designed for recovery

• SCAT3 tandem gait protocol appears to be more suitable than SCAT5
Concussion Recovery:
Rest vs Exercise

Trouble Falling Asleep After Concussion
Is Associated With Higher Symptom
Burden Among Children and Adolescents

David R. Howell, PhD, ATC1,2,3,4, Jessie R. Oldham, PhD1,2,3,4,
Anna N. Brilliant, BS1,2,5, and William P. Meehan III, MD1,2,3,4

Table 3. Multivariable Independent Association of Clinical Predictor Variables and Trouble Falling Asleep After Concussion.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>Standard error</th>
<th>95% confidence interval</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior experience for headache</td>
<td>3.99</td>
<td>2.24</td>
<td>1.04, 15.40</td>
<td>.05</td>
</tr>
<tr>
<td>Confusion1</td>
<td>3.14</td>
<td>1.29</td>
<td>1.01, 9.67</td>
<td>.04</td>
</tr>
<tr>
<td>1 of school or more missed due to injury*</td>
<td>4.03</td>
<td>2.46</td>
<td>1.02, 15.56</td>
<td>.03</td>
</tr>
<tr>
<td>Nausea</td>
<td>3.34</td>
<td>1.28</td>
<td>0.92, 10.55</td>
<td>.12</td>
</tr>
<tr>
<td>Feeling like a fog</td>
<td>1.38</td>
<td>0.61</td>
<td>0.71, 2.21</td>
<td>.33</td>
</tr>
<tr>
<td>Sensitivity to sounds*</td>
<td>1.58</td>
<td>0.25</td>
<td>1.04, 2.66</td>
<td>.03</td>
</tr>
<tr>
<td>Don’t keep right</td>
<td>3.64</td>
<td>1.25</td>
<td>1.06, 10.90</td>
<td>.08</td>
</tr>
</tbody>
</table>

*Significantly associated with trouble falling asleep in the 24 hours prior to evaluation.

Acute Cognitive and Physical Rest May Not Improve Concussion
Recovery Time

Thomas A. Buckley1, Barry A. Morikasy2, and Brandy P. Clouse3
Recovery Timeline:
• Aerobic exercise → 13 days
• Stretching → 17 days

<table>
<thead>
<tr>
<th>Variable</th>
<th>Exercise group</th>
<th>No exercise group</th>
<th>P value</th>
<th>Cohen's d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gait evaluation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single-task gait speed (m/s)</td>
<td>1.03 (0.90-1.14)</td>
<td>0.99 (0.92-1.13)</td>
<td>0.30</td>
<td>0.39</td>
</tr>
<tr>
<td>Dual-task gait speed (m/s)†</td>
<td>0.81 (0.65)</td>
<td>0.78 (0.65)</td>
<td>0.82</td>
<td>0.62</td>
</tr>
<tr>
<td>Cognitive evaluation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single-task accuracy [% correct]</td>
<td>98 (77-100%)</td>
<td>98 (76-100%)</td>
<td>0.84</td>
<td>0.20</td>
</tr>
<tr>
<td>Dual-task accuracy [% correct]</td>
<td>100 (94-102%)</td>
<td>99 (95-100%)</td>
<td>0.89</td>
<td>0.19</td>
</tr>
<tr>
<td>Modified BESS evaluation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single leg stance errors</td>
<td>1.5 (0.5-6)</td>
<td>3 (1-6)</td>
<td>0.48</td>
<td>0.19</td>
</tr>
<tr>
<td>Tandem stance errors</td>
<td>1 (0-3)</td>
<td>1 (0-3)</td>
<td>0.77</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Clinical Implications

• Sleep disturbances are associated with poor clinical outcomes.

• Strict rest is no longer appears to be the appropriate prescription.

• Aerobic exercise initiation earlier in recovery may help facilitate recovery.
Subsequent Injury following Return to Play

The main finding of this study was that in high school athletes, concussion increased the risk of sustaining a subsequent time-loss lower extremity injury but did not increase the risk of injury to other body parts. Previous research emphasizes the importance of concussions in the high school level, where an increase in concussions leads to an increased number of subsequent lower extremity injuries. Consequently, in this study, it was found that higher concussions increased the risk of sustaining a subsequent lower extremity injury in concussed compared with non-concussed children. The concussion injury risk was found to be particularly high in the population of young athletes. Therefore, understanding the musculoskeletal injury risk after concussion in this age group is important.
Sports-related concussion increases the risk of subsequent injury by about 50% in elite male football players

Anna Nordström, Peter Nordström, Jan Ekstrand

What are the new findings?

- There was an increased risk of a subsequent injury within the year following concussion in elite football players.
- Analysis of previous injury history revealed that those elite football players who subsequently sustained a concussion had also suffered more injuries than their counterparts who did not suffer concussion (i.e., concussion may be part of an ‘injury prone’ phenotype/behaviour).

Concussion Frequency Associates with Musculoskeletal Injury in Retired NFL Players

Briana Petrosino1,2, Yvonne M. Colledge1,4,5, Jason P. Mihalec1,2,3, and Kevin M. Guskiewicz1,2,3

DISCUSSION

Our study provides evidence of the association between self-reported concussions and musculoskeletal injuries sustained in the NFL. The overall odds of reporting a musculoskeletal injury increased when a greater frequency of concussions was also reported. Regardless of the reported concussion frequency, there was a notable increase in the odds of reporting a knee or ankle injury in former NFL players that reported any number of concussions. Associations were significantly higher for all musculoskeletal injury categories in players reporting three or more concussions. For all musculoskeletal injury categories, except for hamstring/quadiceps strains, there was a trend for increasing estimates as the number of reported concussions increased.

Why?
Clinical Implications

• Are certain individuals just injury prone?
  – Higher rates of injury pre-concussion (Lynall et al., 2015; Nordstrom et al., 2015; Burman et al., 2016)

• Should injury prevention programs be put in place?

• Dual task challenges appear exacerbate differences