Concussion Management: From Rehab to Return to Activity

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Professor and Director, Athletic Training
A.T. Still University
Disclosure Statements

• The statements and opinions contained in this program are solely those of the presenter.
• Treatment options and tools presented are some of many that are available.
• All individuals in control of content disclosed no relevant financial relationships.
• Other CE disclosures can be found in your course information document.
Learn how you can take an active role in helping your patients return to school and activity safely after a concussion. This course overviews how to implement academic adjustments post-concussion, explains the role of exertion and active rehabilitation, and discusses return to play recommendations and clearance.
Objectives

At the end of this course, the attendee will be able to:

• Describe the management of school-related concerns following a concussion

• Discuss the role of exertion and active rehabilitation

• Explain return-to-play recommendations, including the profession to full clearance
Speaker Biography

Tamara Valovich McLeod, PhD, ATC, FNATA
Professor and Director, Athletic Training
A.T. Still University

- Received bachelor’s degree in sports medicine from Mercyhurst University and master of science in Kinesiology from the University of Colorado
- Completed doctor of philosophy degree in education with an emphasis in sports medicine from the University of Virginia
- Fellow of the National Athletic Trainers’ Association
- Director of ATSU's Arizona School of Health Sciences Interdisciplinary Research Laboratory and the Athletic Training Practice Based Research Network
- Research focuses on pediatric athlete with respect to sport-related concussion
- Contributing author for NATA's position statement of the Management of Sport Related Concussion
- Serves as section editor for the Journal of Athletic Trainer and in on the editorial board for numerous other athletic training journals
Module 1: Academic Consequences and Managing Return to Learn Following Concussion
Comprehensive Concussion Plan

PPE

Equipment

Baseline

Post-Injury Testing

Return to School

RTP

Referral Sources
Comprehensive Concussion Plan

- PPE
- Equipment
- Baseline
- Post-Injury Testing
- Return to School
- RTP
- Referral Sour
Consensus Questions

• What is the evidence for and efficacy of specific treatment interventions?

• What is the difference in concussion management in children as compared to adults?
Key Recommendations

• Brief period (24–48 hours) of complete rest

• Closely monitored active rehabilitation programs
  • Controlled sub-symptom threshold, submaximal exercise

• Full return to school

• Need to address academics
  • Successfully return to school first, then sport!

McCrory et al, Br J Sport Med. 2017
Return to Learn
Return-to-Learn Implications

35 included studies
• Academic outcomes, physician recommendations, length of RTP progression, symptom difficulties, academic accommodations

Inconsistent findings
• Small number of studies, variability in terminology and methodology

Gaps
• Consensus on RTL protocols, prescription of cognitive rest, RTL legislation, evidence-based RTL progressions, impact of RTL on academic outcomes

O’Neill, 2017
## Effects of Concussion on Learning

<table>
<thead>
<tr>
<th>Somatic</th>
<th>Cognitive</th>
<th>Sleep</th>
<th>Emotional</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Affects ability to function in class</td>
<td>• Difficulty learning and retaining new information</td>
<td>• Results in issues with cognition, behavior, and mood</td>
<td>• Anxiety can hinder cognition</td>
</tr>
<tr>
<td>• Unsteadiness</td>
<td></td>
<td>• Decreased alertness in class</td>
<td>• Adherence to prescribed rest</td>
</tr>
<tr>
<td>• Concentration difficulty</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Concussion & Academic Outcomes

**Negative**

- Cumulative GPA significantly lower in youth with 2+ concussions & recent concussion (Moser, 2005)
- Higher academic dysfunction scores 1 week after concussion compared to extremity injured (Wasserman, 2016)
- Symptomatic students had increased level of concern for impact of concussion on academic performance and more school related problems (Ransom, 2015)
- Vision symptoms, hearing difficulty, and concentration difficulty were significantly associated with academic difficulty (Swanson, 2016)
- 79% of ATs managed patient who experienced a decrease in school and academic performance following concussion (Williams, 2015)

**None**

- Concussion did not alter academic outcomes when using end of year GPA (Russel, 2016)
Concussion & Academic Outcomes

Influence on school attendance and activities
- Academic accommodations
- Left school early due to symptoms
- Decrease in grades
- Wanted to be in school

Effect on school role
- Physical symptoms impact on school
- Absences
- Academic adjustments
- Inconsistency of school personnel in assisting

Valovich McLeod, In Review
Iadevaia, 2015
Who Has Problems in School?

1/3 of patients presenting to specialty clinic had school problems

Higher initial 3 of symptoms
- 9.5 (6.7) vs. 2.6 (6.0)

Higher Initial Symptom Severity
- 23.3 (22.2) vs. 13.5 (17.0)

Significantly Worse SCAT2 Score (total)
- 60.8% no absence
- 24.1% missed 1-3 d
- 16.5% missed 4-21 d

Baker, 2015
Policies to Aid Return to School
## Return-To-Learn Policy

### Secondary School
- 44% of ATs had RTL policy (Kasamatsu, 2016)
- 24.3% address AA in written plan (Heyer, 2015)
- 30% written policy (Wing, 2015)
- 12% had RTL Policy (Lyons, 2016)

### College
- 66.6% of colleges had RTP policies (Kerr, 2016)
- 3.1% involved academic support
- 86.4% had RTL section (Buckley, 2017)
Policies

- Temporary Academic Adjustments
- 504 Plans
- Individualized Education Plans (IEP)
## Accommodations

<table>
<thead>
<tr>
<th>Type of Accommodation</th>
<th>Definition</th>
<th>Time frame</th>
<th>Implementation Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Academic Adjustment</strong></td>
<td>Non-formalized changes in environment</td>
<td>3-5 weeks</td>
<td>Informal negotiation with teachers and academic administrators</td>
</tr>
<tr>
<td><strong>Academic Accommodation</strong></td>
<td>Longer academic accommodation needs (i.e. alternative arrangements for standardized testing)</td>
<td>5 weeks – 4 months</td>
<td>504 Plan</td>
</tr>
<tr>
<td><strong>Academic Modification</strong></td>
<td>More prolonged changes necessary (special education)</td>
<td>&gt; 4- 6 months</td>
<td>Individualized Education Plan (IEP)</td>
</tr>
</tbody>
</table>
School – Medical Partnership: Policy and Infrastructure
### Activities and Responsibilities: Before School Year

**Goal: Written Policy, Verification of Education, List of Resources**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concussion management policies and procedures (P &amp; P)</td>
<td>School administration [school nurse, counselor, psychologist]</td>
</tr>
<tr>
<td>Development of school concussion resource team</td>
<td>School administration; school nurse, counselor, psychologist, designated teacher, athletic trainer</td>
</tr>
<tr>
<td>Examine teaching/support methods to support recovery, maximize learning/ performance, reduce symptom exacerbation</td>
<td>School administration; school nurse, counselor, psychologist</td>
</tr>
<tr>
<td>Teacher/staff education and training</td>
<td>Teacher, school counselor, school nurse, administrators</td>
</tr>
<tr>
<td>Develop list of concussion resources for education, consultation &amp; referral</td>
<td>School administrators</td>
</tr>
</tbody>
</table>
Activities and Responsibilities: During School Year

Goal: Have tools available for assessment and education

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review/reinforce concussion policy and procedures</td>
<td>School administration, school nurse/counselor</td>
</tr>
<tr>
<td>Monitoring for injury, parent informed of injury</td>
<td>Coach, athletic trainer, school health personnel</td>
</tr>
</tbody>
</table>
## Activities and Responsibilities: Post-Injury

**Goal:** Proper documentation, written plans for school and activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical evaluation &amp; school treatment planning</td>
<td>Licensed health care professional with concussion training, school concussion resource team</td>
</tr>
<tr>
<td>Gradual return to school program</td>
<td>Licensed health care professional with concussion training, school concussion resource team</td>
</tr>
<tr>
<td>In-school observation, monitoring, &amp; supports</td>
<td>School concussion resource team</td>
</tr>
<tr>
<td>Clearance for full return to academics</td>
<td>Licensed health care professional with concussion training, school concussion resource team</td>
</tr>
</tbody>
</table>
School Support Infrastructure

- Defining and training an interdisciplinary school concussion management team
- Professional development of the school and medical communities with respect to concussion management in the school
- Identification, assessment, and progress monitoring protocols
- Availability of a flexible set of intervention strategies to accommodate the student's recovery needs
- Systematized protocols for active communication among medical, school, and family team members

Gioia, 2016
School System Preparation

1. Establish state and local school policies and procedures
   • Identification and academic management of students with mild traumatic brain injury

2. Educate school personnel about mild traumatic brain injury
   • Formation and role definition of the school-based team

3. Implementation of school-based concussion management action plans
Common Themes in Students with Mild Traumatic Brain Injury

- Formal education and training of school personnel
- Definition of roles for all with respect to activities and strategies to promote recovery
- Preparation of the school environment, noting possible triggers of symptom exacerbation
- Use of standardized forms to guide teaching staff in symptom monitoring, support provision and communication
- Development and active use of a student-specific medical management plan
- Regular, ongoing communication between the medical, school, and family to ensure understanding of the student’s evolving medical, academic, and social-emotional support needs

Giola, 2016
School System Concussion Education

• Concussion and their effects
• Each professional’s role in management
• Start of the school year
• Includes teachers, counselors, administrators, coaches, and medical providers
• Staff familiarized with policy
Medical System Preparation

• **Training Resources for Medical Providers**
  • General concussion education
  • Use of assessment tools
  • Use of TBI-specific discharge instructions and planning tools (ACE)

• **Communication with School Personnel**
Medical – School Partnership

- Effective and efficient communication of the students’ needs
- Student’s symptom profile can be communicated to the team
- Periodic in-school monitoring of symptom progress can be conducted
  - Cognitive activity log
Ideal Policy

- Brief description of mild traumatic brain injury/ concussion
- Definition of the school “receiving team” to guide reentry
- The gradual process to assist the student’s return into school life (learning, social activity, etc.),
- Criteria for when students can safely return to physical activity and full cognitive activity

Giola, 2016
Concussion Management Team
Secondary School (AT)

Secondary School (No AT)

- Coach
- School Nurse
- Team Physician
- Outside referral sources
- Counselor
- Teachers
- Parents
- Student

Elementary School

# Teams and Their Roles

<table>
<thead>
<tr>
<th>Team</th>
<th>Team Members</th>
<th>Roles</th>
</tr>
</thead>
</table>
| Family                | Patient, parents, guardians, relatives, peers, teammates, family friends    | Impose rest  
Monitor and track symptoms at home including emotional and sleep-related symptoms daily  
Communicate with school teams |
| Medical               | Primary care provider, team physician, emergency department, concussion specialist, neuropsychologist, other medical referrals | Rule out more serious injury  
Evaluate patient periodically  
Coordinate information from other teams  
Encourage physical and cognitive rest |
| School Academic       | School nurse, school counselor, teachers, school psychologist, social worker, school administrator, school physician, school occupational or physical therapist | Reduce cognitive load  
Meet with patient to create academic adjustments  
Watch, monitor, and track academic and emotional issues |
| School Physical Activity | Athletic trainer, school nurse, coach, physical education teacher, school physician, playground supervisor | Watch, monitor, and track physical symptoms  
Athletic trainer should do daily follow-up examinations  
Ensure no physical activity |

Williams & Valovich McLeod, Quick Consult: Concussion, 2015
Collaboration

• School personnel and health care providers play important and cooperative roles.

• School personnel provide expertise in developing the academic adjustments:
  • Need guidance from the health care providers on the specific targets toward which they should direct the school supports.

• Medical evaluation and the resulting student symptom profile is the first step to constructing the plan of accommodations and adjustments.

Iverson & Gioia, 20XX
### Case Manager / Point Person

Table 4. Summary of “Point Persons” Identified to Monitor Health (n = 1037) and Academic Progress (n = 1011)

<table>
<thead>
<tr>
<th>Point Person</th>
<th>Health and Recovery, n (%)</th>
<th>Academic Progress, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athletic trainer</td>
<td>764 (73.7)</td>
<td>359 (35.5)</td>
</tr>
<tr>
<td>Principal or assistant principal</td>
<td>115 (11.1)</td>
<td>24 (2.4)</td>
</tr>
<tr>
<td>No one currently identified</td>
<td>86 (8.3)</td>
<td>212 (21.0)</td>
</tr>
<tr>
<td>Athletic director</td>
<td>27 (2.6)</td>
<td>26 (2.6)</td>
</tr>
<tr>
<td><strong>School counselor</strong></td>
<td>22 (2.1)</td>
<td>174 (17.2)</td>
</tr>
<tr>
<td>Coach</td>
<td>11 (1.1)</td>
<td>8 (0.8)</td>
</tr>
<tr>
<td>Teacher</td>
<td>5 (0.5)</td>
<td>75 (7.4)</td>
</tr>
<tr>
<td>School psychologist</td>
<td>4 (0.4)</td>
<td>13 (1.3)</td>
</tr>
<tr>
<td>Nurse or health clerk</td>
<td>3 (0.3)</td>
<td>120 (11.9)</td>
</tr>
</tbody>
</table>

Kasamatsu, 2016

AT Perspective
Case Manager / Point Person

Percentage of Respondents

Principal Perspective

Heyer, 2014
Frequency of Communication with School Professionals

Kasamatsu, 2016
Familiarity with 504s and IEPs

School Nurses

Physicians

PAs

ATs

Welch Bacon, 2016
School Personnel & AA

• School personnel felt minimally to moderately knowledgeable and confident in their knowledge

• Coaches had highest perceived knowledge and confidence
  • Past educational efforts regarding concussion have focused on coaches (Sarmiento, 2010)

• Educational efforts directed at school personnel are needed
  • Pediatric sports medicine providers can play a key role in facilitating education and collaboration
RTL Law Implementation

Qualitative Study of MA Law Implementation

• 19 school stakeholders
• Required re-entry plan for academics

At Schools of All Respondents

• SNs and ATs developed a collaborative relationship to implement the law
• Physicians were relied on for diagnosis

Challenges to Reliance on Outside Physicians

• Perception they knew little about the law

“... (the athletic trainer) does a good job with the paper work and the documentation and the communication between the two of us... I get an email from her all the time about... somebody had a head injury or a potential concussion. She’ll give me a heads up so that we have that information at school in the morning... when kids are here for class. “

Doucette, 2016
Important Factors for CMT

Years of experience (Valovich McLeod, 2014)
- Important for building collaborative relationships and understanding the intricacies of concussion management, which includes AA

Employment model (McLeod, 2015)
- Employed directly by the school more likely to have policy and greater familiarity with AA
Importance of AT Access

• School counselors with AT access were more familiar with 504 and IEP (Johnson, 2017)
  • 53.2% vs. 28.3%

• School administrators with ATs agreed more strongly that they were knowledgeable about and were more confident in their knowledge regarding AA, RTL, and RTP criteria post-SRC (Johnson, 2016)

• AT employment was associated with more school administrators (Kasamatsu, 2016)
  • Reported AA provided to student-athletes following concussion (73.3% vs. 26.7%)
  • Reported existence of an established academic support team (78.7% vs. 21.3%)
Barriers to Collaboration

- **Community physician knowledge** (Williams, 2015; Kay, 2015; Sleight, 2015; Erickson, 2015; Doucette, 2016; Blackwell, 2016)

- **Communication with physician** (Doucette, 2016; Blackwell 2016)

- **Lack of collaboration** (Minthorn, 2014)
  - Only half of SNs with an AT have an established professional relationship

- **Teacher knowledge and training** (Lyons, 2016; Valovich McLeod, PRISM, 2017)

- **Limited access to school counselors** (Blackwell, 2016)
Areas of Improvement

**Speech Language**
- Better communication
- More training in TBI
- Improved access to assessment tools

**School Nurses**
- Communication (73%)
- Training (38%)
- Time (30%)
- Perception not SN role (15%)

**School Nurses**
- Communication
- Standardized protocols
- Education on managing younger patients
- Communication about non-sports concussions

**Athletic Trainer**
- Patient/Parent compliance
- Education
- Formal Policy
- Inconsistency between RTP and RTL

Duff, 2014
Wing, 2015
Blackwell, 2016
Welch Bacon, In Press
Plan Implementation
Academic Support Plan

16-36% of respondents indicated school has an academic support plan in place (Valovich McLeod, Kines Rev, 2015)
## Academic Support Plan

<table>
<thead>
<tr>
<th><strong>Who?</strong></th>
<th>Medical, School, Athletic, and Family</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What?</strong></td>
<td>Written Concussion Play&lt;br&gt;Communication</td>
</tr>
<tr>
<td><strong>When?</strong></td>
<td>Preseason&lt;br&gt;In-Season</td>
</tr>
<tr>
<td><strong>Where?</strong></td>
<td>School or district level&lt;br&gt;Athletic trainer, directing physician level</td>
</tr>
<tr>
<td><strong>How?</strong></td>
<td>In-services and educational sessions&lt;br&gt;Routine practice</td>
</tr>
</tbody>
</table>
Medical School Partnership

CMT trained for role

Initial medical evaluation

CMT translates symptom profile into AA

Student-specific MTBI management plan developed

Periodic in school monitoring of symptoms

Regular on-going communication between CMT

Medical School Partnership

Gioia, 2016
### Progressive Activities of Controlled Exertion (PACE)

<table>
<thead>
<tr>
<th>Stage 1: Set the Positive Foundation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishes a positive, optimistic, active problem-solving context</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 2: Define the Parameters of Activity-Exertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define a daily schedule</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 3: Teach Activity-Exertion Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaches concepts: “not too little and not too much” activity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage 4: Reinforce Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery is dynamic; activity-exertion management will reduce symptoms</td>
</tr>
</tbody>
</table>

Gioia, 2016
Return to School Strategy

Daily activities at home that do not give the child symptoms

School activities

Return to school part-time

Return to school full time

McCrory, 2017
What Type of Adjustments?

• Prospective study of 318 adolescent patients
• 23.6% missed school days
• Reported on Day 3
  • 66% noted changes to academic performance
  • 17.3% received AA

<table>
<thead>
<tr>
<th>Changes to Academic Performance (D3)</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reported changes, but no AA received</td>
<td>61%</td>
<td>43/70</td>
</tr>
<tr>
<td>Reported changes, and received AA</td>
<td>34.3%</td>
<td>24/70</td>
</tr>
<tr>
<td>Did not report changes, but received AA</td>
<td>4.3%</td>
<td>3/70</td>
</tr>
</tbody>
</table>
Readiness to Return

Symptoms Affect Ability to Concentrate or Tolerate Stimulation Up to 30 min

• Should likely remain home

• May participate in light mental activities below symptom threshold

• Limit computer use and video games

Halstead, AAP, 2013
Readiness to Return

When Able to Tolerate Symptoms for 30-45 min

- Consider starting RTL progression at home or at school with adjustments
- Level of adjustments depend on severity, type and duration of symptoms

Halstead, AAP, 2013
Adjustments for Physical Symptoms

**Headache**
- Frequent breaks
- Reduce exposure to aggravators
- Rest in nurse’s office

**Dizziness**
- Allow student to put head down
- Early dismissal between classes to avoid crowded halls

**Visual Symptoms**
- Reduce exposure to computers, videos
- Reduce brightness on screens
- Allow hat or sunglasses
- Audiotapes for books

Halstead, AAP, 2013; Nationwide Children's, REAP
Adjustments for Cognitive Symptoms

- **Difficulty Concentrating**
  - Avoid testing or major projects
  - Extra time
  - Consider notes, notetaker, scribe

- **Mentally Foggy**
  - Give breaks
  - Simplify tasks

- **Difficulty Paying Attention**
  - Have student sit in front of room
  - Work in quiet room

Halstead, AAP, 2013; Nationwide Children's, REAP
Adjustments for Sleep Symptoms

**Sleep Disturbances**
- Allow for late start or shortened day
- Allow rest breaks

**Fatigue**
- Strategic rest
- Schedule adjustments

Halstead, AAP, 2013; Nationwide Children’s, REAP
### Adjustments for Emotional Symptoms

<table>
<thead>
<tr>
<th>Anxiety</th>
<th>Depression</th>
<th>More Emotional</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reassurance</td>
<td>• Time built in for socialization</td>
<td>• Have signal with teacher to leave/rest</td>
</tr>
<tr>
<td>• Workload reduction</td>
<td></td>
<td>• Allow student to leave from classroom</td>
</tr>
<tr>
<td>• Alternate forms of testing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Halstead, AAP, 2013; Sady, 2011; Nationwide Children's, REAP
Example RTL Progression

- Jane is a 15 year old soccer player
- Enrolled in AP English and Math
- Sustains a concussion in a game on Friday
- Presents with moderate headache, difficulty concentrating, and difficulty remembering on Monday morning

**STAGE 0: No return, at home**
- Cognitive rest
- Remain at home Monday
- Avoid strenuous mental activities
- Determine if symptoms reduce with rest
Example RTL Progression

Tuesday
• Headache decreased but still present
• Difficulty concentrating and remembering improving

STAGE 0: No return, at home
• Symptom limited mental activity
• Cognitive readiness challenge
  • Reading or math for 10-30 min
  • Assess symptoms
  • She is able to read for 30 minutes without symptom exacerbation
  • Symptoms improve with rest breaks
Example RTL Progression

**Wednesday**
- Headache decreased even more
- Difficulty concentrating and remembering improving, but still a concern with AP courses

**STAGE 1: Return Partial Day**
- Attend classes as tolerated
- Rest breaks as needed
- No homework

- She is able to make it through 4 of 6 periods taking 2 breaks
Example RTL Progression

Thursday
• Headache resolved
• Able to concentrate better
• Still concerns with remembering

STAGE 2: Full Day, maximal support
• Attend classes as tolerated
• Rest breaks as needed
• No homework or tests

• She is able to make it through all classes with only one break
Example RTL Progression

Friday
• Headache resolved
• Able to concentrate
• Still concerns with remembering

STAGE 3: Full day, moderate support
• Attend classes as tolerated
• Rest breaks as needed
• Modified assignments

• She is able to make it through all classes without symptoms
Example RTL Progression

Following Monday
• Headache resolved
• Able to concentrate
• Able to remember

STAGE 4: Full day, minimal support
• Attend classes as tolerated
• Modified assignments

• She is able to make it through all classes without symptoms
Example RTL Progression

Following Tuesday
• Headache resolved
• Able to concentrate
• Able to remember
• Did not need breaks yesterday

STAGE 5: Full day, no supports
• Full class schedule
• She is able to make it through all classes without symptoms
• Develop plan with teachers to addressed missed work
Take Home Points

• Academics are a significant stressor and consideration in managing concussion in children and adolescents
• Schools and medical provider should work together to develop appropriate plans
• Medical and school personnel should be part of the academic support team
• Returning to school should follow a stepwise progression based on the students clinical presentation
Module 2
Concussion Treatment and Active Rehabilitation

REST

Physical Rest
Cognitive Rest
Cognitive Rest

- **No Activity**: Asleep or comatose
  - Goal: limit cognitive activity to a level that is tolerable and does not exacerbate symptoms

- **Full Activity**: Normal school
<table>
<thead>
<tr>
<th>Year</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMSSM, 2012</td>
<td>Students will require <strong>cognitive rest</strong> and may require academic accommodations such as reduced workload and extended time for tests while recovering from a concussion.</td>
</tr>
<tr>
<td>AAN, 2013</td>
<td>LHCPs might develop individualized graded plans for return to physical and <strong>cognitive activity</strong>, guided by a carefully monitored, clinically based approach to minimize exacerbation of early postconcussive impairments (Level C).</td>
</tr>
<tr>
<td>NATA, 2014</td>
<td>Athletic trainers should work with school administrators and teachers to include appropriate <strong>academic accommodations</strong> in the concussion-management plan. Strength of Recommendation: C</td>
</tr>
</tbody>
</table>
| Berlin, 2017 | • Brief period of complete rest (24-48 hr)  
|           | • Gradual and progressive sub-symptom threshold activity                           |
Clinical Questions

1. How often is cognitive and physical rest, including academic adjustments, utilized by health care providers in managing sport-related concussion?

2. In patients sustaining a concussion, does the use of physical and cognitive rest reduce the severity and duration of concussion-related impairments?
<table>
<thead>
<tr>
<th>Study</th>
<th>Key Results</th>
</tr>
</thead>
</table>
| Arbogast, 2013    | 62% of physicians described awareness of CR as part of management; only 2.4% described CR in detail  
11% of charts reviewed included written CR recommendations                                                                                          |
| Carson, 2014      | Worsening of symptoms in 44.7% of patients following premature RTL  
Patients with prior history of concussion required more rest days before being cleared                                                             |
| Grubenhoff, 2015  | Patients with PPCS missed 50% more school days than patients with no PPCS  
36% of PPCS patients received AA, while 53% of no PPCS patients received AA  
There was an association between follow-up visits and receiving AA (RR=2.2; 95% CI = 1.4-3.5)                                                    |
| Olympia, 2015     | 58% of SN are responsible for guiding students’ graduated academic re-entry process                                                                                                                        |
| Upchurch, 2014    | CR was not recommended to any patient prior to 2008  
CR was only recommended to 12% of patients by 2012                                                                                                |
| Weber, 2015       | 59.4% of student-athletes with concussion under SN care received AA, yet only 27.7% of SN always or almost always recommend AA following sport-related concussion                                                   |
| Wilkins, 2013     | Instructions for RTT increased from 24% prestandardization to 98% poststandardization                                                                                                                        |
| Williams, 2015    | 41% of student-athletes with concussion under AT care received AA                                                                                                                                          |
| Zemek, 2015       | CR recommendations were limited; 40% of physicians did not recommend school absence, 30% did not recommend schoolwork reduction, 35% did not recommend limiting screen time                                           |

Effectiveness of Rest

3 studies showing too much activity delayed recovery = worse outcomes (Majerske, 2008; Brown, 2014; Maerlender, 2015)

2 studies show rest improves outcomes (Moser, 2012, 2015)

4 studies found no association between rest and outcomes (Gibson, 2013; Buckley, 2015; Moor, 2015; deKruijk, 2002)

1 RCT found strict rest resulted in a longer recovery (Thomas, 2015)
1. Physical and cognitive rest is underutilized by healthcare providers (SOR = B)
   • Need to educate community providers regarding best practices for rest, treatment, and activity
   • Develop strategies to build a collaborative concussion management team

2. Moderate physical and cognitive rest may facilitate recovery during the initial days after concussion (SOR = B)
   • Recommendations for rest are broad and not specific for individual patients
   • An initial period of rest may be beneficial
   • Balance rest and active treatments for each patient
   • For athletic trainers, these decisions are ones that should be made in conjunction with their directing physician and in collaboration with other concussion team members

Activity or Rest?

- No school or exercise activity [X]
- School activity only
- School activity and light activity at home [✓]
- School and sports practice
- School and sports games [X]

Majerske, JAT, 2008
Rest

• Brief period (24–48 hours) of complete rest

• Gradually and progressively more active
  • Staying below their cognitive and physical symptom
  • Avoid heavy exertion

• The exact amount and duration of rest is not yet well defined

Schneider, BJSM, 2017
Post-Concussion Management

Acute management
• Remove
• Immediate referral / red flags

Sub-symptom treatment/rehabilitation
• Based on symptom presentation
• As tolerated

Return to activity progression
• Testing to return to sport
• Functional progression

Protection Phase

Deficit Management Phase

Return to Sport Phase

Lundblad, 2017
Refer: Treatment

• Preliminary evidence supporting use of active rehab and treatment
• Individualized symptom-limited aerobic exercise programs
  • Patients with persistent post-concussive symptoms associated with autonomic instability or physical deconditioning
• Targeted physical therapy
  • Patients with cervical spine or vestibular dysfunction
• Collaborative approach including cognitive behavioral therapy
  • Persistent mood or behavioral issues.

McCrory et al, Br J Sport Med. 2017
Rehabilitation

• A variety of treatments may be required for ongoing symptoms and impairments

• Cervical and vestibular rehabilitation
  • Persisting dizziness, c-spine pain and headaches

• Closely monitored active rehabilitation programmes
  • Controlled subsymptom threshold, submaximal exercise

• Specific treatments based on clinical examination findings and symptoms.
Refer: Persistent Symptoms

• Beyond expected time frames (ie, >10–14 days in adults and >4 weeks in children)

• Multimodal clinical assessment
  • Needed to identify specific primary and secondary pathologies that may be contributing to persisting post-traumatic symptoms

• Treatment should be individualized
  • Target-specific medical, physical and psychosocial factors identified

McCrory et al, Br J Sport Med. 2017
Concussion is Treatable
Premise for Treatment

“Rest”
• Avoidance of exacerbating activities

No need to shut down areas that do not exacerbate symptoms
• Able to tolerate light aerobic exercise without increasing symptoms?
• Able to read without increasing symptoms?
• Able to attend school without increasing symptoms?
Treatment
Intervention that occurs between injury and RTP
May include interventions done after RTP

Return to Play
Progression from medical clearance to return to sport and full, unrestricted play
Clinical Pathways

• Can we predict patient outcomes?
• Can we determine the best treatments for each patient based on initial clinical presentation?
Clinical Pathways

- Risk Factors
  - Prior concussions
  - Migraine
  - LD/ADHD
  - Sex
  - Age
  - Medical hx

- Concussion
  - Immediate clinical presentation

- Clinical Trajectories
  - Vestibular
  - Ocular
  - Cognitive
  - Migraine
  - Anxiety / Mood
  - Cervical

- Treatment Pathways
  - Cognitive rest
  - Physical rest
  - Vestibular rehabilitation
  - Medications
  - Cognitive-speech therapy
  - Early exercise
  - Manual therapy

Collins, 2013
Using Concussion Clinical Trajectories to Inform Targeted Treatment Pathways

Risk Factors

- Previous Concussions
- Migraine
- LD/ADHD
- Female Gender
- Age
- Motion Sensitivity
- Ocular Hx

Clinical Trajectories

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

Individualized Treatment

- Symptom Limited Activity
- Light Exercise
- Sports Specific Exercise
- Non Contact Training
- Medical Clearance
- Full Contact Practice
- Return to Activity
Concussion Clinical Trajectories

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

## COACH-CV

**C**
- Cognitive
- Neuropsychological referral

**O**
- Oculomotor
- Refer neuro-optometrist, optometrist with concussion experience, OT

**A**
- Affective
- Refer for counseling, psychiatrist, psychologist

**C**
- Cervical
- Refer for physical therapy

**H**
- Headache
- Treat with analgesics, anti-migraine medications

**C**
- Cardiovascular
- Refer for exercise testing (intolerance)

**V**
- Vestibular
- Refer for vestibular rehabilitation

Craton, 2017
## Post-Concussion Disorders

<table>
<thead>
<tr>
<th>Classification</th>
<th>Characteristics</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological</td>
<td>Persistent concussion symptoms Impairments caused by alterations in cerebral metabolism</td>
<td>Physical and cognitive rest Academic adjustments Sub-symptom threshold aerobic exercise</td>
</tr>
<tr>
<td>Vestibulo-ocular</td>
<td>Vestibular and oculomotor dysfunction</td>
<td>Vestibular and vision rehabilitation Academic adjustments Sub-symptom threshold aerobic exercise</td>
</tr>
<tr>
<td>Cervicogenic</td>
<td>Muscular trauma and inflammation of the cervical area Dysfunction of cervical spine proprioception</td>
<td>Manual therapy Proprioception retraining Balance and gaze stabilization exercises Sub-symptom threshold aerobic exercise</td>
</tr>
</tbody>
</table>
Targeted Treatments

Cognitive/Fatigue
- Difficulty concentrating, overall fatigue, decreased energy levels
- Reduce cognitive and physical demands
- Regulate sleep, stress, diet, and mild exercise (1 short walk/day)

Vestibular
- Dizziness, fogginess, nausea, anxiety, overstimulation by complex environments
- Brought on with rapid head or body movements
- Vestibular rehabilitation

Ocular Motor
- Localized, frontal-based headaches, fatigue, distractibility, difficulty with vision, pressure behind eyes, trouble focusing
- Consult with neuro-optometrist, vestibular therapist
- Rehabilitation with vision therapy specialist

Collins, 2013
<table>
<thead>
<tr>
<th>Targeted Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anxiety/Mood</strong></td>
</tr>
<tr>
<td>• Overall increase in anxiety, perhaps with sleep disturbance and vestibular issues</td>
</tr>
<tr>
<td>• Treat vestibular issues</td>
</tr>
<tr>
<td>• Begin physical exertion protocols and regulate sleep</td>
</tr>
<tr>
<td><strong>Post-traumatic Migraine</strong></td>
</tr>
<tr>
<td>• Moderate to severe headache with nausea and photosensitivity or phonosensitivity, often exaggerated by physical activity and stress</td>
</tr>
<tr>
<td>• Pharmacologic intervention</td>
</tr>
<tr>
<td><strong>Cervical</strong></td>
</tr>
<tr>
<td>• Headache and neck pain</td>
</tr>
<tr>
<td>• ROM, manual cervical and thoracic mobilization, posture education, biofeedback, soft tissue mobilization</td>
</tr>
</tbody>
</table>
Treatment Team

- Athletic Trainer
- Sports Medicine/Team physician
- Sport Physical Therapist
- Vestibular Therapist
- Neurologist
- Neurosurgeon
- Neuropsychologist
- Occupational Therapist
- School Nurse

- Speech & Language Pathologist
- Physical Medicine & Rehabilitation physician
- Ocular Therapist
- Behavior Optometrist
- Psychologist
- Psychiatrist

**Adjunct Team Members**
Coach, Teacher, Academic Counselor, Family
Sleep

Address sleep issues first

• Systems regarding arousal, alertness, attention and sleep are vulnerable after TBI (Ponsford, 2012)
• Perceived sleep disturbance related to greater symptom burden and lower neurocognitive scores (Kostyun, 2014)

Good sleep hygiene

• Aim for similar sleep/wake times each day
• Quiet, dark environment
• Avoid visual stimulation from electronics
Mood Disturbances

• Concussion can result in anxiety, depression, emotional disturbances (Ponsford, 2012; Hutchison, 2009; Mainwaring, 2004; Kontos, 2012)

• Treatment
  • Referral to psychologist, psychiatrist, cognitive rehab
  • Cognitive Behavior Intervention (Hodgson, 2005)
  • Mood stabilizing medications
  • Structured environment (Collins, 2014)
    • Understand stress of removing from social (sport)
    • Allow some time with teammates
    • Active treatments may reduce stress
# Headaches

## Cervicogenic

- **Hemicranial pain referred to the head by bony or soft tissue structures of the neck** (Biondi, 2005)

## Treatment (Page, 2011)

- Postural correction
- Manual therapy
- Modalities
- Exercise therapy
- Breathing patterns

## Migraine

- **Pre-existing condition may be exacerbated**
- **Migraine presentation can occur after concussion**
- **Can be caused by related vestibular dysfunction**

## Treatment

- Medications
- Vestibular rehabilitation
Exercise as an Intervention

- Improved cognitive function after TBI
- Symptom resolution
- Mood improvement
- Improved neuroplasticity, cortical connectivity & activation
- Improved regulation of cerebral blood flow

Crane, 2012; Majerske 2008; Gomez-Pinella, 2011; Maerlender, 2015; Ahlskog, 2011; Colcombe, 2004; Lautenschlager, 2008
Active Rehabilitation

• Closely monitored rehabilitation in post-acute phase improved recovery time in adolescents who were slow to recover (Gagnon, 2009)

• Symptom reduction following active rehabilitation (Dobney, 2017)
  • Physical, cognitive, emotional, sleep

• Symptom reduction occurs regardless of when active rehabilitation is initiated (Dobney, 2017)

• Adverse events (eg. Symptom exacerbation) similar in those with active rehabilitation plus usual care compared to usual care only (Chan, 2017)
Buffalo Concussion Treadmill Test

Test to determine exercise tolerance
- Helps to establish physiological recovery
- Readiness to return to activity

Modified Balke Protocol
- 3.6mph @ 0% incline for 1 minute
- Increase incline by 1% each minute after
- Until maximal incline or patient cannot complete
- RPE, HR, BP, symptoms assessed each 2 minutes

Test is stopped with increased symptoms
- >3 points from pre-test resting symptom score
Buffalo Concussion Treadmill Test

• Good intra-rater reliability and sufficient test-retest reliability (Leddy, 2011)

Recovery in high school athletes (Darling, 2014)
• All athletes returned to sport without symptom exacerbation or recurrent symptoms
• 48% had one or more CNT sub-scores below average
• BCTT better predicted readiness to begin RTP protocol
Buffalo Concussion Treadmill Test

**Assists with differential diagnosis** *(Leddy, 2013)*

- Patients with concussion stop at submaximal level
- If able to exercise to exhaustion without replicating symptoms then symptoms not due to physiologic concussion
  - Cervical injury
  - Vestibular / ocular dysfunction
  - Post-traumatic headache or migraine
Buffalo Concussion Treadmill Test

Assist with exercise treatment (Leddy, 2016)

- Aerobic exercise 20 min/day @ 80% threshold HR
- 5-6 days per week
- Terminate if symptoms appear or after 20 minutes

1. Identify symptom threshold
2. 20 min/day at 80% threshold for 2 weeks
3. If tolerated increase HR by 5-10 bpm
4. 20 min/day at 85-90% threshold without symptom increase
5. Begin RTP progression
Vestibular Rehabilitation Specialists

- Vision impairments
- Headache
- Dizziness
- Sensory organization impairments
Indications for Vestibular Therapy

Atypical Recovery

• Not back to baseline on balance assessment by 10 days post-concussion
• Impaired dynamic visual acuity tests
• Dizziness
• Motion provoked dizziness
• Nausea
• Blurred vision with head movement
• Motion sensitivity
Indications for Vestibular Rehabilitation

**Symptoms**
- Vertigo (especially when lying in bed)
- Dizziness/imbalance
  - No improvement over one week or is persistent beyond two weeks

**Balance impairments**
- Strong Romberg (after one week)
- BESS
  - ↑ BL after 1 wk or > 10 errors per set, > 30 total after 1 wk
- **+ Dix Hallpike**
  - +/- improvement or resolution with Epley maneuver
  - Patients generally like the active nature of participating in their recovery
## Vestibular Rehabilitation After Concussion

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Gaze stabilization (X1)</td>
<td>• ↓ Dizziness rating</td>
</tr>
<tr>
<td>• Standing balance</td>
<td>• ↑ Activities-specific balance confidence scale</td>
</tr>
<tr>
<td>• Walking with balance challenges</td>
<td>• ↓ DHI</td>
</tr>
<tr>
<td>• Canilith repositioning</td>
<td>• ↑ Dynamic gait index</td>
</tr>
<tr>
<td></td>
<td>• ↑ Functional gait assessment</td>
</tr>
<tr>
<td></td>
<td>• ↓ TUG</td>
</tr>
<tr>
<td></td>
<td>• ↑ SOT (all conditions)</td>
</tr>
</tbody>
</table>

Alsalaheen, JNPT, 2010
Effectiveness of Oculomotor Rehab

- Patients with long term issues
- Vergence-based oculomotor rehabilitation was effective in individuals with mTBI who reported near work-related symptoms
- Overall improvement in nearly all of the critical, abnormal measures of vergence was observed both objectively and clinically (Thiagarajan, 2013)
Exercise Interventions

- Avoid stimulating brain activities that are correlated to symptoms
  - Aerobic
  - Coordination
  - Visualization
  - Motivation
  - Education
- Type of exercise
  - Duration
  - RPE
  - HR
  - BP
  - Symptoms
- Initially do not stimulate visual field, vestibular
- Progress to add stimuli
Case Examples
Adolescent Soccer Athlete

Symptom Reports
- Dizziness with movement
- Balance problems
- Headache
- Mild nausea
- Photosensitivity

Past Medical History
- 3 prior concussions

Clinical Exam Findings
- Symptom provocation with VOMS testing
- Balance deficits

Clinical Profile
- Vestibular
- Post-traumatic migraine
Adolescent Soccer Athlete

Treatment plan

• Vestibular rehabilitation
  • Home exercises
• Sleep regulation
• Proper hydration and nutrition
• Light physical activity
• Academic adjustments
## Collegiate Volleyball Athlete

### Symptom Reports
- Trouble focusing
- Fatigue
- Irritability
- Fogginess
- Anxiety

### Past Medical History
- 1 concussion previous season
- Unresolved

### Clinical Exam Findings
- NCT scores normal
- Mild symptom provocation with VOMS
- Increase symptoms with exertion testing

### Clinical Profile
- Anxiety/Mood
- Post-traumatic migraine
- Vestibular
Collegiate Volleyball Athlete

Treatment plan
• Physical activity as tolerated, ideally with friends
• Referral to psychologist
  • Cognitive behavioral therapy
• Sleep regulation
• Appropriate hydration and nutrition
• Vestibular rehabilitation
  • Home exercises
Take Home Points

- Concussion can be treated
- Symptoms-based approach
- Treatment / rehabilitation is distinct from the graduated return to activity progression
- Treat primary, secondary, and tertiary symptom profiles
- Multidisciplinary treatment team
- Progress as symptoms resolve
- Document treatments and progression
Module 3: Return-to-Activity
Institute of Medicine and National Research Council of the National Academies Sports-Related Concussion in Youth October 2013:

“There is little empirical evidence for the optimal degree and duration of physical rest needed to promote recovery or the best timing and approach for returning to full physical activity.”
Rest and Return-to-Activity Following Sport-Related Concussion: A Systematic Review of the Literature

1. How often is cognitive and physical rest, including academic adjustments, utilized by health care providers in managing sport-related concussion?

2. In patients sustaining a concussion, does the use of physical and cognitive rest reduce the severity and duration of concussion-related impairments?

3. How compliant are healthcare providers in following current return-to-activity guidelines?

4. How effective are the graded return-to-activity protocols in improving patient outcomes following concussion?
Compliance With Return to Activity Guidelines

No study found full compliance with using all three recommended areas of concussion-assessment for return-to-play

• Symptoms, cognitive, balance

Significant variability among guideline use by physicians

• Clinical exam cited most for RTA clearance

Lack of compliance with NCAA guidelines

Inadequate ED discharge instructions regarding activity restrictions

Effectiveness of RTA Progression

- No studies specifically evaluated the effectiveness of graded RTA progressions in improving patient outcomes
  - 4 studies evaluated aspects of Zurich statement

- Zurich guidelines + BCTT may provide a useful paradigm for making safe RTA decisions (Darling, 2014)

- Use of a SFWP did not improve clinical outcomes or decrease the risk of a same-season repeat concussion (McCrea, 2009)
In the Past

Colorado Medical Society guidelines for return to play

<table>
<thead>
<tr>
<th>Grade</th>
<th>First concussion</th>
<th>Subsequent concussions</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>15 minutes</td>
<td>1 week</td>
</tr>
<tr>
<td>II</td>
<td>1 week</td>
<td>2 weeks, with physician approval</td>
</tr>
<tr>
<td>IIIa (unconscious for seconds)</td>
<td>1 month</td>
<td>6 month, with physician approval</td>
</tr>
<tr>
<td>IIIb (unconscious for minutes)</td>
<td>6 months</td>
<td>1 year, with physician approval</td>
</tr>
</tbody>
</table>

Based on LOC and amnesia

Cookbook approach and does not take into account individual clinical presentation.
Return to Play Today

Prohibited Same Day Return:

- NFL
- NCAA
- NFHS
- AIA
- Most state laws

- Individualized

- Follows treatment/rehabilitation plan
Post-Concussion Management

Acute management
- Remove
- Immediate referral / red flags

Sub-symptom treatment/rehabilitation
- Based on symptom presentation
- As tolerated

Return to activity progression
- Testing to return to sport
- Functional progression
Early Exercise Interventions

• Treatment/ rehabilitation

• Determine symptoms and what exacerbates symptoms
  • Allow sub-symptom threshold exercise in areas that are not effected
  • Introduce light aerobic activity early
  • Train areas without deficits

• Gradually add challenges that may exacerbate symptoms
  • Once symptoms appear, rest and symptoms should start to subside
  • Progress as tolerated – expose then recover
## Early Exercise Interventions

<table>
<thead>
<tr>
<th>Physical</th>
<th>Psychological</th>
</tr>
</thead>
</table>
| • Maintain fitness  
• Physiological benefits of exercise  
• Rehabilitation of affected systems | • Improved compliance  
• Remove isolation  
• Reduction in anxiety  
• Psychological benefits of exercise |
Return to Activity Criteria

School
• Full return to classroom without accommodations

Symptoms
• No symptoms at rest
• Minimal symptoms that do not increase with activity
• Off medications

Progression
• Transition from treatment/rehabilitation to gradated stepwise RTA protocol
Post-Concussion Management

Acute management
- Remove
- Immediate referral / red flags

Sub-symptom treatment/rehabilitation
- Based on symptom presentation
- As tolerated

Return to activity progression
- Testing to return to sport
- Functional progression

Meet RTA Criteria
Return to Sport

- Graduated stepwise rehabilitation strategy
- Brief period of rest (24-48 hr)
- Symptom limited activity (Stage 1)
  - Staying below physical and cognitive symptom threshold
- Symptom resolution indicator for moving to next stage
- Proceed if able to meet criteria without recurrence of symptoms
- Can include results of adjunct assessments in decision-making
  - Neurocognitive
  - Balance
  - Oculomotor

McCrory, 2017
Return to Play

• Consider the following:
  • Athlete’s previous history of concussion
  • Type of sport (contact vs non-contact)
  • Availability of experienced personnel
    • Observe & monitor athlete during recovery
  • Age

Guskiewicz, J Athl Train. 2004
Modifying Factors

More Conservative Management

<table>
<thead>
<tr>
<th>TABLE 2. Concussion Modifiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factors</td>
</tr>
<tr>
<td>Symptoms</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Signs</td>
</tr>
<tr>
<td>Sequelea</td>
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<tr>
<td>Temporal</td>
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<tr>
<td>Threshold</td>
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<tr>
<td>Age</td>
</tr>
<tr>
<td>Co- and Pre-morbidities</td>
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<td></td>
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<tr>
<td>Medication</td>
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<tr>
<td>Behaviour</td>
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<tr>
<td>Sport</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

McCrory, 2009
### Berlin Progression

- **Rehabilitation/Treatment**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Aim</th>
<th>Activity</th>
<th>Goal of each step</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 slow to medium pace. No resistance training</td>
<td>Increase heart rate</td>
</tr>
<tr>
<td>3</td>
<td>Sport-specific exercise</td>
<td>Running or skating drills. No head impact activities</td>
<td>Add movement</td>
</tr>
<tr>
<td>4</td>
<td>Non-contact training drills</td>
<td>Harder training drills, eg, passing drills. May start progressive resistance training</td>
<td>Exercise, coordination and increased thinking</td>
</tr>
<tr>
<td>5</td>
<td>Full contact practice</td>
<td>Following medical clearance, participate in normal training activities</td>
<td>Restore confidence and assess functional skills by coaching staff</td>
</tr>
<tr>
<td>6</td>
<td>Return to sport</td>
<td>Normal game play</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** An initial period of 24–48 hours of both relative physical rest and cognitive rest is recommended before beginning the RTS progression. There should be at least 24 hours (or longer) for each step of the progression. If any symptoms worsen during exercise, the athlete should go back to the previous step. Resistance training should be added only in the later stages (stage 3 or 4 at the earliest). If symptoms are persistent (eg, more than 10–14 days in adults or more than 1 month in children), the athlete should be referred to a healthcare professional who is an expert in the management of concussion.

~24 hours between each stage

McCrory et al, 2017
Inclusive RTP Progression

**Step 1: Light Exercise**
- Aerobic
- Balance - static
- VOR - seated
- Vision – stable head

**Step 2: Sport-Specific Exercise**
- Aerobic - moderate
- Balance – dynamic & dual tasking
- VOR – stand-walk-jog
- Vision – dynamic and add dual tasking

**Step 3: Non-contact Practice**
- Aerobic – sport-specific, strengthening, plyometrics
- VOR – high speed head movement, sport-specific
- Vision – high demand, sport-specific

**Step 4: Full contact Px**
- Aerobic – BCTT
- Adjunct testing
- Cognitive
- Balance
- Vestibular
- Oculomotor

**Step 5**
- Full return to competition
Reconsider: Elite vs Nonelite

Should be Managed using the same Management Principles

McCrory et al, Br J Sport Med. 2017
Reconsider: Pediatric

- Requires special paradigms suitable for the developing child and adolescent (<18)
  - Child – ages 5-12
  - Adolescent – ages 13-18
- Expected duration of symptoms is 4 weeks
- Age-specific, validated tools
  - Questionable role and utility of computerized testing
- Need to address academics
  - Successfully return to school first, then sport!

McCrory et al, Br J Sport Med. 2017
Rehabilitation After Return

- Musculoskeletal injury after concussion (Lynall, 2015; Pietrosimone, 2015)
- Decreased performance after concussion (Kumar, 2014; Wasserman, 2015)
- Monitoring and documenting symptoms score after the patient has returned
- Continue with vestibular or ocular therapy
Sport-Specific Progressions
## Football

<table>
<thead>
<tr>
<th>Step</th>
<th>Goal</th>
<th>Example Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Light aerobic exercise</td>
<td>Stationary bike&lt;br&gt; No resistance training</td>
</tr>
<tr>
<td>2</td>
<td>Sport-specific non-contact</td>
<td>Individual dynamic warm-up&lt;br&gt; Sprints (5 x 20 yds)&lt;br&gt; Bodyweight circuit (push-ups, sit-ups, jumping jacks)&lt;br&gt; Position-specific non-contact drills (no collision or head impacts)</td>
</tr>
<tr>
<td>3</td>
<td>Non-contact practice</td>
<td>Resistance training&lt;br&gt; Team dynamic warm-up&lt;br&gt; Sprints&lt;br&gt; Plyometric circuit&lt;br&gt; Position-specific non-contact drills (sled and dummy contact)</td>
</tr>
<tr>
<td>4</td>
<td>Unrestricted practice</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Competition</td>
<td></td>
</tr>
</tbody>
</table>
# Soccer

<table>
<thead>
<tr>
<th>Step</th>
<th>Goal</th>
<th>Example Activities</th>
</tr>
</thead>
</table>
| 1    | Light aerobic exercise   | Stationary bike  
No resistance training                                                                                                                          |
| 2    | Sport-specific non-contact | Interval stationary bike  
Sprints – GK: within 18 yd box, agility, cone drills; Field: width of field, agility ladder, cone drills  
15 minutes- Sport-specific non-contact drills – GK: modified warm-up, ball distribution (no diving, no gloves); Field: distance run, passing, volleys, long balls – all kicking only |
| 3    | Non-contact practice     | 30-minutes sport-specific non-contact drills  
No live play  
GK: warm-up, defend controlled shots on goal, no collision, gradual increase into diving (from sitting – kneeling – standing)  
Field: ball drills, shots on goal, possession (red vest), gradual increase in headers |
| 4    | Unrestricted practice    | Full practice without restrictions                                                                                                                  |
| 5    | Competition              |                                                                                                                                                  |
## Basketball

<table>
<thead>
<tr>
<th>Step</th>
<th>Goal</th>
<th>Example Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Light aerobic exercise</td>
<td>Stationary bike&lt;br&gt;No resistance training</td>
</tr>
<tr>
<td>2</td>
<td>Sport-specific non-contact</td>
<td>Individual dynamic warm-up&lt;br&gt;Ball handling, shooting (no rebounding)</td>
</tr>
<tr>
<td>3</td>
<td>Non-contact practice</td>
<td>Resistance training&lt;br&gt;Team dynamic warm-up&lt;br&gt;Position drills&lt;br&gt;Position drills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30-min practice: shell drill, ball handling, shooting drills with team</td>
</tr>
<tr>
<td>4</td>
<td>Unrestricted practice</td>
<td>Full participation in practice</td>
</tr>
<tr>
<td>5</td>
<td>Competition</td>
<td></td>
</tr>
</tbody>
</table>
## Cheer

<table>
<thead>
<tr>
<th>Step</th>
<th>Goal</th>
<th>Example Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Light aerobic exercise</td>
<td>Stationary bike</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No resistance training</td>
</tr>
<tr>
<td>2</td>
<td>Sport-specific non-contact</td>
<td>Individual stunts – no flying or catching</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individual tumbling</td>
</tr>
<tr>
<td>3</td>
<td>Non-contact practice</td>
<td>Resistance training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low difficulty individual stunts – basing, back spotting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low difficulty individual tumbling</td>
</tr>
<tr>
<td>4</td>
<td>Unrestricted practice</td>
<td>Full participation in practice</td>
</tr>
<tr>
<td>5</td>
<td>Competition</td>
<td></td>
</tr>
</tbody>
</table>
# Baseball/Softball

<table>
<thead>
<tr>
<th>Step</th>
<th>Goal</th>
<th>Example Activities</th>
</tr>
</thead>
</table>
| 1    | Light aerobic exercise        | Stationary bike
|      |                               | No resistance training                                                             |
| 2    | Sport-specific non-contact    | Interval stationary bike
|      |                               | Sprints, Bodyweight circuit
|      |                               | Throwing (no catching), hitting off tee, fielding thrown ground balls,             |
| 3    | Non-contact practice          | Progressive resistance training
|      |                               | Limited practice with helmet – no hitting off machine, base running, live drills   |
| 4    | Unrestricted practice         | Full participation in practice                                                     |
| 5    | Competition                   |                                                                                     |
## Swimming

<table>
<thead>
<tr>
<th>Step</th>
<th>Goal</th>
<th>Example Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Symptom limited activity</td>
<td>ADLs\nLight mental activities</td>
</tr>
<tr>
<td>2</td>
<td>Light aerobic exercise</td>
<td>20 minutes: kicking with board\nLand-based – bike or elliptical\nSpeed no faster than aerobic speed or 65% of 100 time</td>
</tr>
<tr>
<td>3</td>
<td>Sport-specific exercise</td>
<td>30 minutes: limited head movement\nAll four strokes, open turns\nSpeed no faster than aerobic speed or 70% of 100 time</td>
</tr>
<tr>
<td>4</td>
<td>Non-contact training drills</td>
<td>30 minutes: More complex interval training\nAll 4 strokes, add coordination and cognitive load, open turns\nSpeed no faster than aerobic speed or 75% of 100 time</td>
</tr>
<tr>
<td>5</td>
<td>Unrestricted practice</td>
<td>Full participation in practice\nIntroduce starts and flip turns</td>
</tr>
<tr>
<td>6</td>
<td>Competition</td>
<td></td>
</tr>
</tbody>
</table>
Legal Aspect Recommendations

• Be aware of all governing bodies and their policies and procedures

• Document athlete’s (and where appropriate, parent’s) understanding of concussive S&S and his/her responsibility to report concussion
  • Informed consent (80% of state laws)
Legal Aspect Recommendations

• Communicate status of concussed patient to managing physician on regular basis

• Ensure proper documentation of the evaluation, management, treatment, RTP progression, and physician communication
Documentation Recommendations

Document all pertinent information regarding the injury, including but not limited to:

• Mechanism of injury
• Initial signs and symptoms
• State of consciousness
• Assessment findings
• Instructions provided
• Referrals to and recommendations from other providers
• Return progression

Guskiewicz, 2004
Documentation

• Specific testing and maneuvers performed

• Dates, times, and locations of testing

• Questions asked of the patient during testing and the patient’s responses
Documentation

- “Performed exertional maneuvers”
  - Attorneys would argue this is NOT sufficient

- “Athlete performed 20 minutes of treadmill running at 5mph, followed by a symptom checklist at 5 and 20 minutes post-exertion”
  - Include notation of the symptom checklist scores
Take Home Points

• Think of the return to activity progression as a part of a rehabilitation continuum

• Sport-specific activities will better aid the patient in progressing
  • Psychological benefits

• Stepwise progression that is supervised, monitored, and documented