



Traumatic Brain Injury / Concussion Commissioner's Grand Rounds

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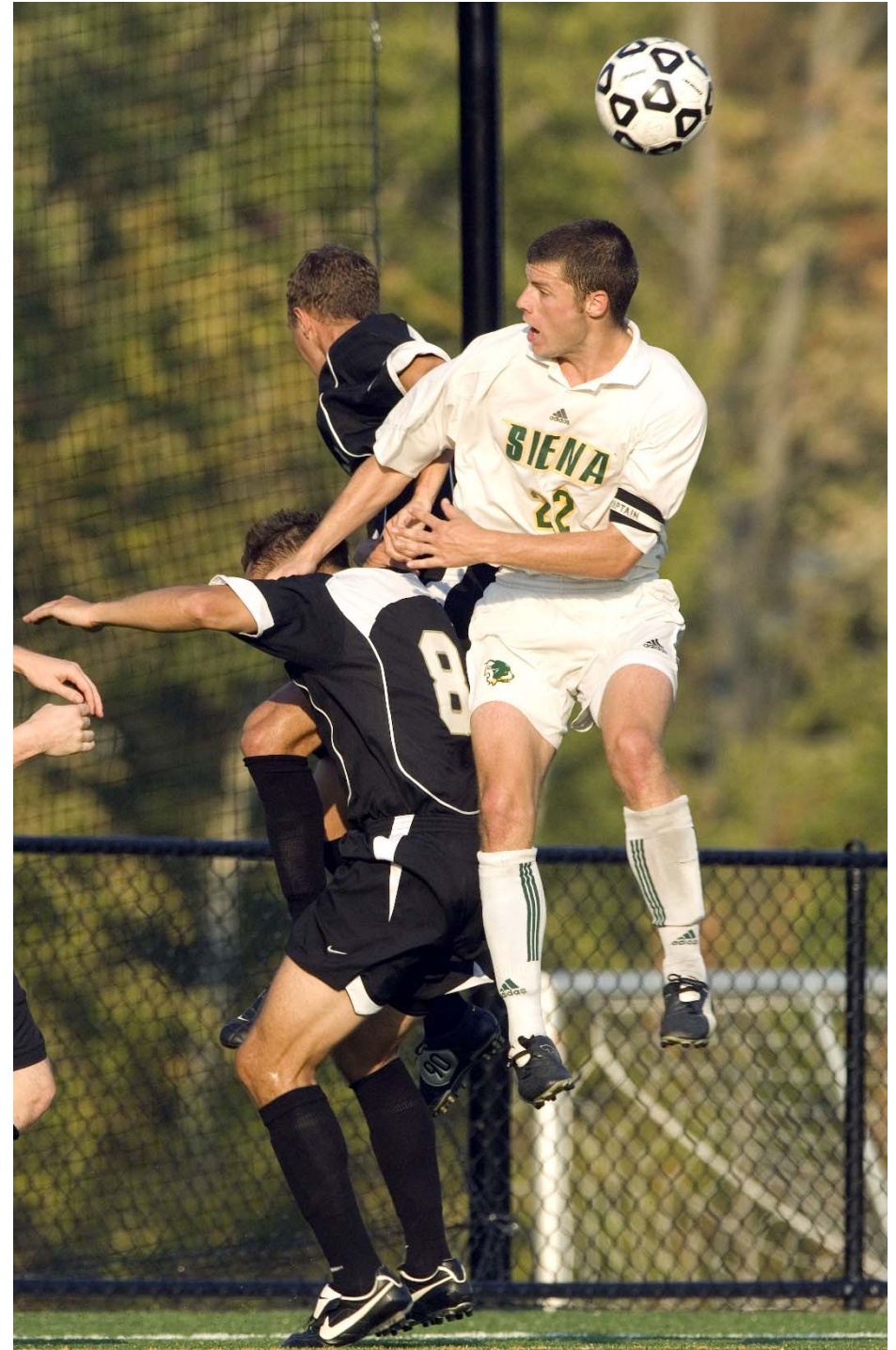
Wednesday November 15th 2017

Goals/Objectives

Topic: New Guidelines from the 2016 Berlin Consensus Conference for Diagnosis & Return to Play After a **Concussion in Sport**

Learning Objectives:

1. Participants will be able to identify the **eleven R's** recovering from a concussion.
2. Participants will describe appropriate steps in decision making while managing a **return to play after a concussion**.





Disclaimers



I am the head team physician for Siena College. I am a concussion consultant for World Rugby, a Tournament Team Physician & Senior Medical Educator. I am Chair of the Medical & Risk Committee for USA Rugby. I am a Fellow of the American Academy of Pediatrics and the American College of Sports Medicine. I serve on the Medical Advisory Board for NYS Athletic Commission.



McCrory P, et al. Br J Sports Med 2017;0:1–10.
doi:10.1136/bjsports-2017-097699

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

Paul McCrory, Willem Meeuwisse, Jiří Dvorak, Mark Aubry, Julian Bailes, Steven Broglio, Robert C Cantu, David Cassidy, Ruben Echemendia, Rudy J Castellani, Gavin A Davis, Richard Ellenbogen, Carolyn Emery, Lars Engebretsen, Nina Feddermann-Demont, Christopher C Giza, Kevin M Guskiewicz, Stanley Herring, Grant L Iverson, Karen M Johnston, James Kissick, Jeffrey Kutcher, John J Leddy, David Maddocks, Michael Makdissi, Geoff T Manley, Michael McCrea, William P Meehan, Sinji Nagahiro, Jon Patricios, Margot Putukian, Kathryn J Schneider, Allen Sills, Charles H Tator, Michael Turner, Pieter E Vos.



Berlin 2016: Eleven R's

- Recognize;
- Remove;
- Re-evaluate;
- Rest;
- Rehabilitation;
- Refer;
- Recover;
- Return to sport;
- Reconsider;
- Residual effects and sequelae;
- Risk reduction



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Berlin 2016: Recognize (SCAT 5)

Sideline evaluation

- The recognition of suspected SRC is therefore best approached using multidimensional testing guided via expert consensus.
- The **SCAT5** currently represents the most well-established and rigorously developed instrument available for sideline assessment.
- There is published support for using the **SCAT** and **Child SCAT** in the evaluation of SRC.
- The **SCAT** is useful immediately after injury in differentiating concussed from non-concussed athletes, but its utility appears to decrease significantly 3–5 days after injury.
- The **symptom checklist**, however, does demonstrate clinical utility in tracking recovery.
- **Baseline testing** may be useful, but **is not necessary** for interpreting post-injury scores.
- If used, clinicians must strive to replicate baseline testing conditions.



Red Flag Immediate Removal

- Loss of consciousness (even if just suspect)
- Ataxia
- Altered mental status (disoriented, confused)
- Hypotonia
- “Rag-doll”
- Seizure
- Tonic posturing



Concussion: Training Room

- Sports Concussion Assessment Tool (SCAT)
 - 5th Edition
 - Endorsed by major international sporting bodies
- Glasgow Coma Scale
- Maddock's Questions
- Symptoms
- Cognitive
- Neck
- Balance/Coordination

SCAT5®

SPORT CONCUSSION ASSESSMENT TOOL – 5TH EDITION

DEVELOPED BY THE CONCUSSION IN SPORT GROUP

FOR USE BY MEDICAL PROFESSIONALS ONLY

supported by



FIFA®



FEI

Child SCAT5[®]

SPORT CONCUSSION ASSESSMENT TOOL
FOR CHILDREN AGES 5 TO 12 YEARS
FOR USE BY MEDICAL PROFESSIONALS ONLY

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FEI

- <http://bjsm.bmj.com/content/bjsports/early/2017/04/26/bjsports-2017-097492childscat5.full.pdf>

BJSM

Sport concussion assessment tool for childrens ages 5 to 12 years

Br J Sports Med published online April 26, 2017

BJSM

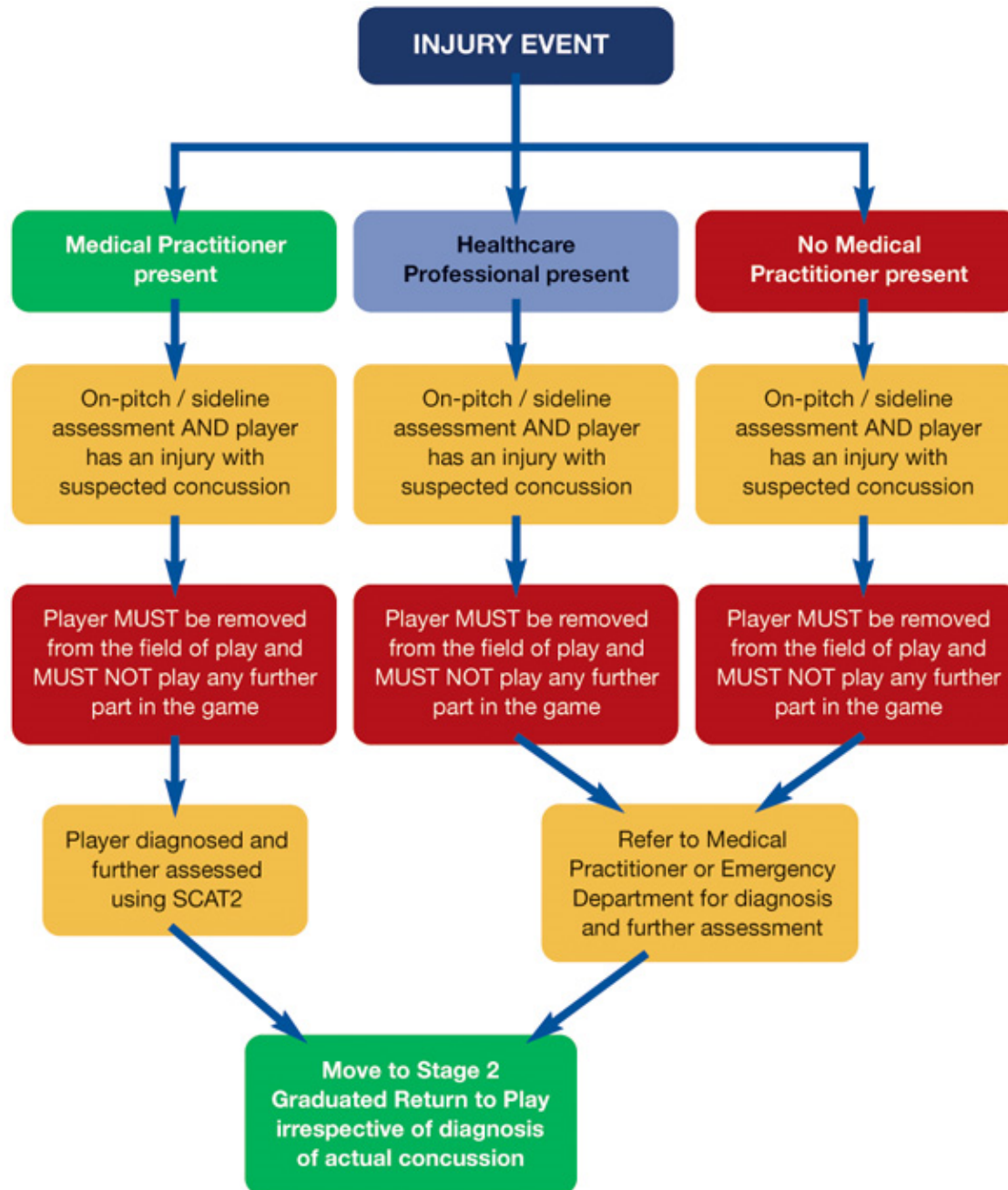
The Child Sport Concussion Assessment Tool 5th Edition (Child SCAT5)

Gavin A Davis, Laura Purcell, Kathryn J Schneider, Keith Owen Yeates, Gerard A Gioia, Vicki Anderson, Richard G Ellenbogen, Ruben J Echemendia, Michael Makdissi, Allen Sills, Grant L Iverson, Jiri Dvorak, Paul McCrory, Willem Meeuwisse, Jon Patricios, Christopher C Giza and Jeffrey S Kutcher

Br J Sports Med published online April 26, 2017

Immediate Care

- Injury management dependent on who is field side
- Many sports injuries occur without any medical staff present



Echemendia RJ, et al. Br J Sports Med 2017;0:1–2.
doi:10.1136/bjsports-2017-097508

The Concussion Recognition Tool 5th Edition (CRT5)

Ruben J Echemendia, Willem Meeuwisse, Paul McCrory, Gavin A Davis, Margot Putukian, John Leddy, Michael Makdissi, S John Sullivan, Steven P Broglio, Martin Raftery, Kathryn Schneider, James Kissick, Michael McCrea, Jiri Dvorak, Allen K Sills, Mark Aubry, Lars Engebretsen, Mike Lossemore, Gordon Fuller, Jeffrey Kutcher, Richard Ellenbogen, Kevin Guskiewicz, Jon Patricios, Stanley Herring.

ABSTRACT

The Concussion Recognition Tool 5 (CRT5) is the most recent revision of the Pocket Sport Concussion Assessment Tool 2 that was initially introduced by the Concussion in Sport Group in 2005. The CRT5 is designed to assist non-medically trained individuals to recognise the signs and symptoms of possible sport-related concussion and provides guidance for removing an athlete from play/sport and to seek medical attention. This paper presents the development of the CRT5 and highlights the differences between the CRT5 and prior versions of the instrument.



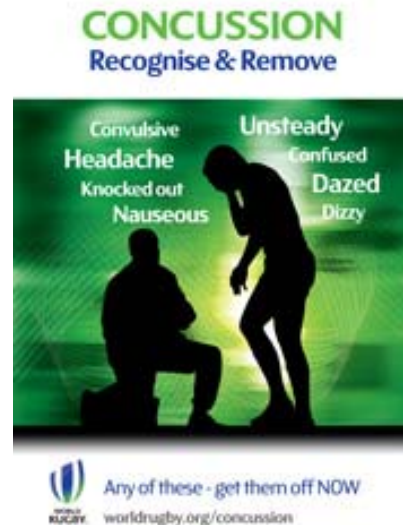
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Berlin 2016: Remove

- When a concussion is suspected, the athlete should be removed from the sporting environment and a multimodal assessment should be conducted in a standardized fashion (e.g. **SCAT5**).
- Sporting bodies should allow **adequate time** to conduct this evaluation.
- For example, completing the SCAT alone typically takes **10 min**.
- The final determination regarding SRC diagnosis and/or fitness to play is a **medical decision based on clinical judgement**.



Berlin 2016: Remove

PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Removal From Play After Concussion and Recovery Time

R.J. Elbin, Alicia Sufrinko, Philip Schatz, Jon French, Luke Henry, Scott Burkhart,
Michael W. Collins and Anthony P. Kontos

Pediatrics 2016;138;

DOI: 10.1542/peds.2016-0910 originally published online August 29, 2016;

- Athletes who were not removed from play took longer to recover and demonstrated worse neurocognitive and symptom outcomes after a sport-related concussion.
- Removal from play status is a new predictor for protracted recovery and supports consensus guidelines.

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Berlin 2016: Re-evaluate

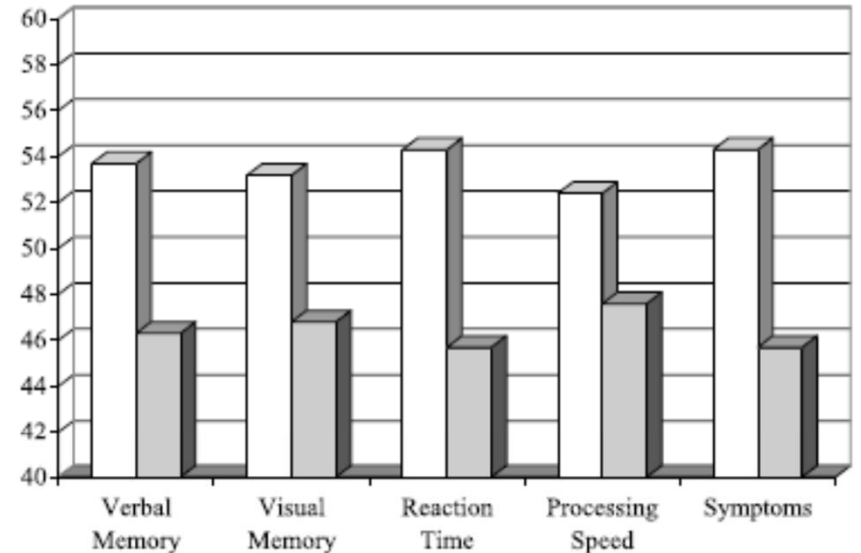
- An athlete with SRC may be evaluated in the **emergency room** or **doctor's office** as a point of first contact after injury or may have been referred from another care provider.
- Key features of follow-up examination should encompass:
 - a. A **medical** assessment
 - b. Determination of the clinical status of the patient, improvement or **deterioration** since the time of injury.
 - c. Determination of the need for emergent **neuroimaging** to exclude a more severe brain injury.



Berlin 2016: Re-evaluate

- Neuropsychological assessment

- Neuropsychological assessment (NP) has been previously described by the CISG as a '**cornerstone**' of SRC management.
- The application of NP testing in SRC has **clinical value** and **contributes significant information** in SRC evaluation.
- Baseline or pre-season NP testing was considered and was **not felt to be required** as a mandatory aspect of every assessment; however, it may be helpful or add useful information to the overall interpretation of these tests.



Psychology Press The Clinical Neuropsychologist
Taylor & Francis Group 2003, Vol. 17, No. 4, pp. 460-467

1385-4046/03/1704-460\$16.00
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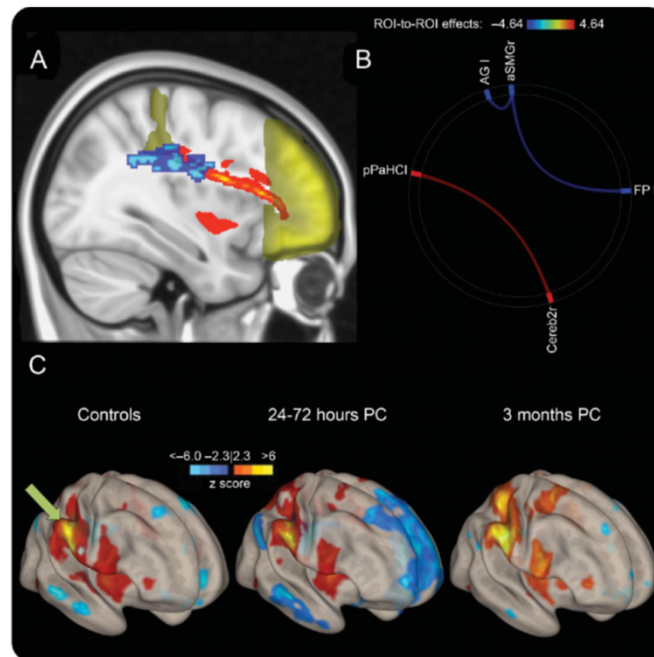
Interpreting Change on ImpACT Following Sport Concussion

Grant L. Iverson¹, Mark R. Lovell², and Michael W. Collins²

¹Department of Psychiatry, University of British Columbia & Riverview Hospital, Vancouver, BC, Canada, and ²Department of Orthopaedic Surgery, University of Pittsburgh Medical Center, Sports Medicine Concussion Program, Pittsburgh, PA, USA

Berlin 2016: Re-evaluate

- Advanced neuroimaging, fluid biomarkers and genetic testing are important research tools, but require further validation to determine their ultimate clinical utility in evaluation of SRC.



Neurology®

Multiparametric MRI changes persist beyond recovery in concussed adolescent hockey players

Kathryn Y. Manning, Amy Schranz, Robert Bartha, et al.
Neurology published online October 25, 2017
DOI 10.1212/WNL.0000000000004669

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Berlin 2016: Rest

- Rest may ease discomfort during the acute recovery period by mitigating post-concussion symptoms and/or that rest may promote recovery by minimizing brain energy demands following concussion.
- There is currently insufficient evidence that prescribing complete rest achieves these objectives.
- 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.



Benefits of Strict Rest After Acute Concussion: A Randomized Controlled Trial
 Danny George Thomas, Jennifer N. Apps, Raymond G. Hoffmann, Michael McCrea
 and Thomas Hammeke
Pediatrics: originally published online January 5, 2015;
 DOI: 10.1542/peds.2014-0966

- Strict Rest v Usual Care
- Strict Rest did worse

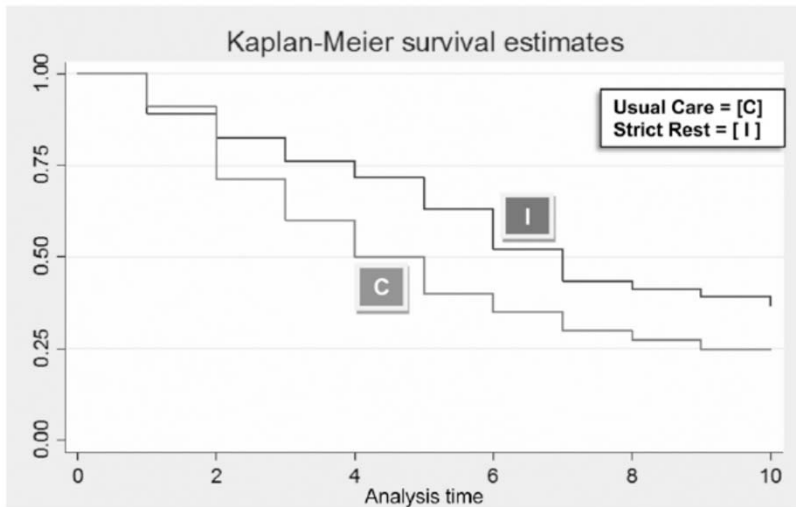


FIGURE 4
 Proportion of patients reporting symptom resolution (PCSS ≤ 7) over time. It took longer for 50% the intervention group to report symptom resolution. However, the difference in overall proportion of patient reporting symptom resolution did not meet statistical significance ($P = .08$).

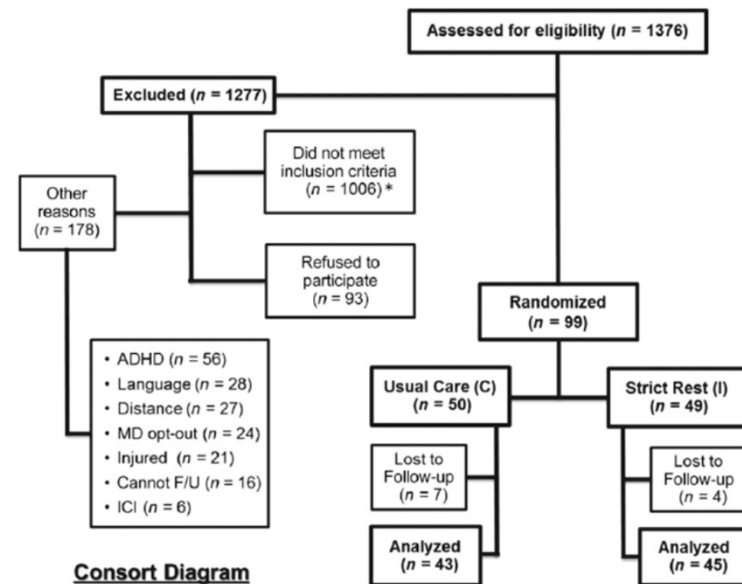


FIGURE 2
 CONSORT (Consolidated Standards of Reporting Trials) diagram. ADHD, attention-deficit/hyperactivity disorder; F/U, follow-up; ICI, intracranial injury. *Did not meet inclusion criteria because they were not diagnosed with concussion.

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Berlin 2016: Rehabilitate

- SRCs can result in diverse symptoms and problems, and can be associated with concurrent injury to the **cervical spine** and **peripheral vestibular system**.
- The data support interventions including **psychological, cervical and vestibular rehabilitation**.
- In addition, closely monitored active rehabilitation programs involving controlled **sub-symptom-threshold, submaximal exercise** have been shown to be safe and may be of benefit in facilitating recovery.



Rehabilitate

- Leddy & Willer 2013
- Curr Sports Med Reports
- The Buffalo Concussion Treadmill Test has been shown to diagnose physiologic dysfunction in concussion safely and reliably, differentiate it from other diagnoses (e.g., cervical injury), and quantify the clinical severity and exercise capacity of concussed patients.
- It is used to establish a safe aerobic exercise treatment program to help speed recovery and return to activity.



Figure 2: Use of the BCTT and exercise prescription for RTA in physiologic PCD. APMHR, age-predicted maximum HR. *After 3 wk of symptoms. **5 bpm for nonathletes; 10 bpm for athletes. To obtain a more precise target HR, consider repeating the BCTT every 2 wk.

Use of Graded Exercise Testing in Concussion and Return-to-Activity Management

John J. Leddy, MD, FACSM FACP¹ and Barry Willer, PhD²

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Berlin 2016: Refer



Persistent symptoms

- The Berlin expert consensus is that use of the term ‘persistent symptoms’ following SRC should reflect failure of normal clinical recovery—that is, symptoms that persist beyond expected time frames (ie, >10–14 days in adults and >4 weeks in children).

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Berlin 2016: Recovery

- The strongest and most consistent predictor of slower recovery from SRC is the severity of a person's **initial symptoms** in the first day, or initial few days, after injury.
- The development of subacute problems with **migraine headaches or depression** are likely risk factors for persistent symptoms lasting more than a month.
- Those with **attention deficit hyperactivity disorder** or **learning disabilities** might require more careful planning and intervention regarding returning to school, but they do not appear to be at substantially greater risk of persistent symptoms beyond a month.

Original Investigation

Clinical Risk Score for Persistent Postconcussion Symptoms Among Children With Acute Concussion in the ED

Roger Zemek, MD; Nick Barrowman, PhD; Stephen B. Freedman, MDCM, MSc; Jocelyn Gravel, MD; Isabelle Gagnon, PhD; Candice McGahern, BA; Mary Aglipay, MSc; Gurinder Sangha, MD; Kathy Boutis, MD; Darcy Beer, MD; William Craig, MDCM; Emma Burns, MD; Ken J. Farion, MD; Angelo Mikrogjanakis, MD; Karen Barlow, MD; Alexander S. Dubrovsky, MDCM, MSc; Willem Meeuwisse, MD, PhD; Gerard Gioia, PhD; William P. Meehan III, MD; Miriam H. Beauchamp, PhD; Yael Kamil, BSc; Anne M. Grool, MD, PhD, MSc; Blaine Hoshizaki, PhD; Peter Anderson, PhD; Brian L. Brooks, PhD; Keith Owen Yeates, PhD; Michael Vassilyadi, MDCM, MSc; Terry Klassen, MD; Michelle Keightley, PhD; Lawrence Richer, MD; Carol DeMatteo, MSc; Martin H. Osmond, MDCM; for the Pediatric Emergency Research Canada (PERC) Concussion Team

IMPORTANCE Approximately one-third of children experiencing acute concussion experience ongoing somatic, cognitive, and psychological or behavioral symptoms, referred to as persistent postconcussion symptoms (PPCS). However, validated and pragmatic tools enabling clinicians to identify patients at risk for PPCS do not exist.

OBJECTIVE To derive and validate a clinical risk score for PPCS among children presenting to the emergency department.

DESIGN, SETTING, AND PARTICIPANTS Prospective, multicenter cohort study (Predicting and Preventing Postconcussive Problems in Pediatrics [5P]) enrolled young patients (aged 5- <18 years) who presented within 48 hours of an acute head injury at 1 of 9 pediatric emergency departments within the Pediatric Emergency Research Canada (PERC) network from August 2013 through September 2014 (derivation cohort) and from October 2014 through June 2015 (validation cohort). Participants completed follow-up 28 days after the injury.

EXPOSURES All eligible patients had concussions consistent with the Zurich consensus diagnostic criteria.

MAIN OUTCOMES AND MEASURES The primary outcome was PPCS risk score at 28 days, which was defined as 3 or more new or worsening symptoms using the patient-reported Postconcussion Symptom Inventory compared with recalled state of being prior to the injury.

← Editorial page 987

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[JAMA Report Video at jama.com](#)

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[Supplemental content at jama.com](#)

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[CME Quiz at jamanetworkcme.com](#) and [CME Questions page 1050](#)

- ER based clinical risk score within 48 hours of head injury
- Modest discrimination to predict persistent post concussion symptoms at 28 days

Roger Zemek *et al.* JAMA 2016 315(10)
1014-1025

Risk factors for concussion prevention?

Concussion Risk Factors and Strategies for Prevention

Hamish A. Kerr, MD, MSc, FAAP, CAQSM

Abstract

Concussion in children is frequently related to participation in sports. It requires a traumatic event to occur that transmits acceleration to the brain. Some children may have intrinsic risk factors that place them at greater risk for this type of injury. Comorbidities such as attention-deficit/hyperactivity disorder, migraine headaches, and mood disorders may place athletes at increased risk of more severe injury. A previous concussion is probably the most important influence on risk for future injury. Extrinsic risk factors include coaching techniques, officiating, and choice of sport. Helmet choice does not diminish concussion risk, nor does the use of mouth guards. Education of athletes, coaches, parents, and physicians is very important in improving recognition of potential concussive injury and helping child athletes and their parents understand the risks involved in sport participation. [Pediatr Ann. 2014;43(12):e309-e315.]



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Disclosure: Hamish A. Kerr has no relevant financial relationships to disclose. doi: 10.3928/00904481-20141124-10

Pediatric Annals Dec 2014

- Intrinsic Risk
 - Genetics
 - Age/Gender
 - Neck Strength
 - **Neurological or psychiatric comorbidity**
- Extrinsic Risk
 - **Previous concussive injury**
 - Protective equipment (helmets)
 - Choice of Sport
 - Style of Play
 - Coaching
 - Rules & Refereeing
 - Knowledge Gaps
 - Laws & legislation

Berlin 2016: Recovery

Establishing time of recovery for SRC

- Recent literature suggests that the physiological time of recovery may outlast the time for clinical recovery.
- The consequence of this is as yet unknown, but one possibility is that athletes may be exposed to additional risk by returning to play while there is ongoing brain dysfunction.
- Multiple studies suggest that physiological dysfunction may outlast current clinical measures of recovery, supporting a **'buffer zone'** of gradually increasing activity before full contact risk.



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Berlin 2016: Return to Sport

- Graduated return to sport



Consensus statement

Table 1 Graduated return-to-sport (RTS) strategy

Stage	Aim	Activity	Goal of each step
1	Symptom-limited activity	Daily activities that do not provoke symptoms	Gradual reintroduction of work/school activities
2	Light aerobic exercise	Walking or stationary cycling at slow to medium pace. No resistance training	Increase heart rate
3	Sport-specific exercise	Running or skating drills. No head impact activities	Add movement
4	Non-contact training drills	Harder training drills, eg, passing drills. May start progressive resistance training	Exercise, coordination and increased thinking
5	Full contact practice	Following medical clearance, participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6	Return to sport	Normal game play	

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.

- Supervision of process by school athletic trainer is key

Berlin 2016: Eleven R's

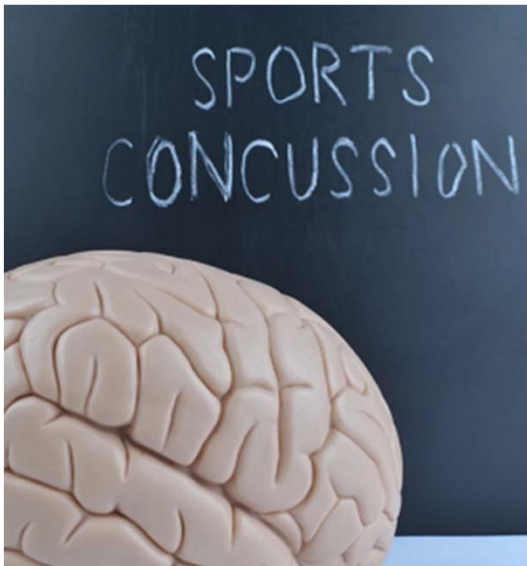
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Berlin 2016: Reconsider

Elite and non-elite athletes

- All athletes, regardless of level of participation, should be managed using the same management principles.



The child and adolescent athlete

- Children and adolescents should not return to sport until they have **successfully returned to school.**
- However, early introduction of symptom-limited physical activity is appropriate.

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Berlin 2016: Risk reduction

Role of pre-participation SRC evaluation

- A structured SRC history should include specific questions as to previous symptoms of an SRC and length of recovery, not just the perceived number of past SRCs.

Prevention

- While it is impossible to eliminate all concussion in sport, concussion-prevention strategies can reduce the number and severity of concussions in many sports.

Risk factors for concussion prevention?

Concussion Risk Factors and Strategies for Prevention

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Abstract

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Disclosure: Hamish A. Kerr has no relevant financial relationships to disclose. doi: 10.3928/00904481-2014124-10

Pediatric Annals Dec 2014

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 - Rules & Refereeing
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Berlin 2016: Risk reduction

Prevention: Equipment

- There is sufficient evidence in terms of reduction of overall head injury in **skiing/snowboarding** to support strong recommendations and policy to mandate helmet use in skiing/snowboarding.
- The evidence for **mouth guard** use in preventing SRC is mixed, but meta-analysis suggests a **non-significant trend** towards a protective effect in collision sports.

Prevention: Rules & Policy

- The strongest evidence evaluating policy is related to **body checking in youth ice hockey** (i.e. no checking < 13) which demonstrates a consistent protective effect in reducing the risk.



Berlin 2016: Risk reduction

Prevention: Sport-Specific

- There is some promise that vision training in **collegiate American football** players may reduce SRC.
- Limiting contact in **youth football practices** has demonstrated some promising results in reducing the frequency of head contact, but there is no evidence to support the translation of these findings to a reduction in SRC.
- Evaluation of fair play rules in **youth ice hockey**, tackle training without helmets and shoulder pads in youth **American football**, and tackle technique training in professional **rugby** do not lead to a reduction in SRC risk.
- A recommendation for stricter rule enforcement of red cards for high elbows in heading duels in professional **soccer** is based on evidence supporting a reduced risk of head contacts and concussion with such enforcement.

Risk Reduction: Tackle technique

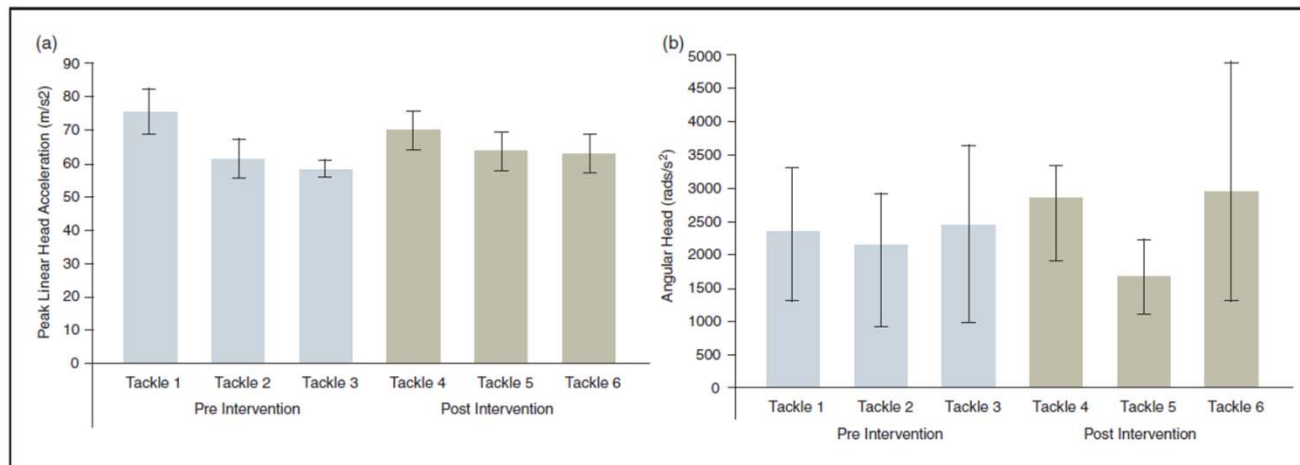


Figure 3. (a) Mean peak linear head accelerations pre- (Tackles 1–3) and post-intervention (Tackles 4–6) and (b) mean peak angular head accelerations pre- (Tackles 1–3) and post-intervention (Tackles 4–6) in high school rugby.

Original research

Does instructional video footage improve tackle technique?

Hamish A Kerr¹, Eric H Ledet², Ashar Ata¹, Jennifer L Newitt¹,
Matthew Santa Barbara³, Milan Kahanda¹ and
Erin Sperry Schlueter¹

International Journal of
Sports Science
& Coaching

International Journal of Sports Science
& Coaching

0(0) 1–13

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DOI: 10.1177/1747954117711867

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Conclusions: Eleven 'R's

- Berlin 2016 focus on recognition
- Timeline to recovery altered (especially for kids)
- Return to learn emphasis
- Concussion prevention



Questions

Which of the following is a recommended tool for the general public to use to assess a concussion?

- a. Sports Concussion Assessment Tool, Version 5
- b. Sideline Assessment of Concussion
- c. Concussion Recognition Tool, Version 5
- d. ImPACT testing

True or False?

- Multiple studies suggest that physiological dysfunction may outlast current clinical measures of recovery, supporting a 'buffer zone' of gradually increasing activity before full contact risk.