



**PASIG** **PERFORMING ARTS**  
SPECIAL INTEREST GROUP



**ORTHOPAEDIC SECTION**  
AMERICAN PHYSICAL THERAPY ASSOCIATION



**PASIG MONTHLY CITATION BLAST: No.98**

**October 2014**

Dear Performing Arts SIG members:

**CSM 2015 is around the corner!** (Indianapolis, Indiana, February 4-7, 2015) The PASIG educational programming will be given by Clare Frank DPT, MS, OCS, FAAOMPT on Dynamic Neuromuscular Stabilization in Spinal Rehabilitation & Performance. We hope you will all also attend the **PASIG Business Meeting at CSM 2015**—more details to follow!

**Attention PT students! For those of you who will be presenting a Performing Arts-content poster or platform for APTA CSM 2015:** We offer a student scholarship through the PASIG for accepted presentations. If you would like information about this student scholarship, please e-mail Amy Humphrey, PT, DPT, OCS, MTC at [amymarieis@comcast.net](mailto:amymarieis@comcast.net) The deadline is Nov. 15<sup>th</sup>, 2014.

**Looking for an opportunity to share case reports, clinical pearls, or original research?** Have you recently encountered an interesting patient case in the performing arts? Please consider submitting to the **PASIG section of the Orthopaedic Practice Magazine**. If you have further questions about submitting a case report, please contact Annette Karim at [neoluvsonlyme@aol.com](mailto:neoluvsonlyme@aol.com).

We have a **Twitter** account! Visit <https://twitter.com/PT4Performers> for updates.

We are working on a closed PASIG Facebook page. Until then, we share the Orthopaedic Section Facebook page, and can post there. Interested in posting? Contact Dawn Muci: [Dawnd76@hotmail.com](mailto:Dawnd76@hotmail.com)

Starting a Performing Arts-related fellowship? Interested in networking with others working on fellowship development? Contact Mariah Nierman:  
[Mariah.Nierman@osumc.edu](mailto:Mariah.Nierman@osumc.edu)

Remember, PASIG membership is free to all orthopaedic section members.  
[https://www.orthopt.org/sig\\_pa\\_join.php](https://www.orthopt.org/sig_pa_join.php)

### **OTHER RESEARCH OPPORTUNITIES**

1. We still need writers for the 2014 Citation blasts!!!) These are put together on a monthly basis. Please contact me for more information, at [brookerwinder@gmail.com](mailto:brookerwinder@gmail.com). Go to the website to look at topics that have been covered, add new content or update old citation topics:  
[http://www.orthopt.org/content/special\\_interest\\_groups/performing\\_arts/citations\\_endnotes](http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes)
2. If you are seeking research participants, or are seeking a researcher to work with your potential participants, contact both Brooke Winder, Research Chair: [Brookerwinder@gmail.com](mailto:Brookerwinder@gmail.com) and Amanda Blackmon, Membership Chair: [mandy@onetherapy.com](mailto:mandy@onetherapy.com)
3. We are working on creating a brief dance screen as a resource for the PASIG website. The new contact for dance screening is Sarah Wenger: [Sbw28@drexel.edu](mailto:Sbw28@drexel.edu)

This month's citation blast highlights research published in 2013 and 2014 on concussion diagnosis, management, and prognosis. I hope you find this information helpful in your practice!

Best regards,

*Brooke*

Brooke Winder, PT, DPT, OCS

Chair, PASIG Research Committee

*Director of Physical Therapy, The Cypress Center, Pacific Palisades, CA*

Home: [brookeRwinder@gmail.com](mailto:brookeRwinder@gmail.com) Work: [brooke@thecypresscenter.com](mailto:brooke@thecypresscenter.com)

#### **PASIG Research Committee members:**

Shaw Bronner PT, PhD, OCS, [sbronner@liu.edu](mailto:sbronner@liu.edu)

Jeff Stenback PT, OCS, [jsptocs2@hotmail.com](mailto:jsptocs2@hotmail.com)

Sheyi Ojofeitimi PT, DPT, OCS, [sojofeit@gmail.com](mailto:sojofeit@gmail.com)

Susan D. Fain PT, DMA, [sfain@ptcentral.org](mailto:sfain@ptcentral.org)

Laura Reising, MS, PT, DPT, [lbreising@gmail.com](mailto:lbreising@gmail.com) (EndNote Organizer)



## PERFORMING ARTS CONTINUING EDUCATION, CONFERENCES, AND RESOURCES

Musician Health Series, Janice Ying, PT, DPT, OCS  
Glendale Adventist Therapy and Wellness Center, Los Angeles area (Eagle Rock), CA  
<http://www.musicianshealthcorner.com/>  
[Healthy Musician Series - Overuse](#)

Orthopaedic Section Independent Study Course. *20.3 Physical Therapy for the Performing Artist.*

Monographs are available for:

- Figure Skating (J. Flug, J. Schneider, E. Greenberg),
- Artistic Gymnastics (A. Hunter-Giordano, Pongetti-Angeletti, S. Voelker, TJ Manal),  
and
- Instrumentalist Musicians (J. Dommerholt, B. Collier).

Contact: Orthopaedic Section at: [www.orthopt.org](http://www.orthopt.org)

Orthopaedic Section-American Physical Therapy Association,  
Performing Arts SIG

[http://www.orthopt.org/content/special\\_interest\\_groups/performing\\_arts](http://www.orthopt.org/content/special_interest_groups/performing_arts)

Performing Arts Citations and Endnotes

[http://www.orthopt.org/content/special\\_interest\\_groups/performing\\_arts/citations\\_endnotes](http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes)

ADAM Center

<http://www.adamcenter.net/>

Publications:

<http://www.adamcenter.net/#!vstc0=publications>

Conference abstracts:

<http://www.adamcenter.net/#!vstc0=conferences>

Dance USA

<http://www.danceusa.org/>

Research resources:

<http://www.danceusa.org/researchresources>

Professional Dancer Annual Post-Hire Health Screen:

<http://www.danceusa.org/dancerhealth>

Dancer Wellness Project

<http://www.dancerwellnessproject.com/>

Becoming an affiliate:

<http://www.dancerwellnessproject.com/Information/BecomeAffiliate.aspx>

Harkness Center for Dance Injuries, Hospital for Joint Diseases

<http://hjd.med.nyu.edu/harkness/>

Continuing education:

<http://hjd.med.nyu.edu/harkness/education/healthcare-professionals/continuing-education-courses-cme-and-ceu>

Resource papers:

<http://hjd.med.nyu.edu/harkness/dance-medicine-resources/resource-papers-and-forms>

Links:

<http://hjd.med.nyu.edu/harkness/dance-medicine-resources/links>

Informative list of common dance injuries:

<http://hjd.med.nyu.edu/harkness/patients/common-dance-injuries>

Research publications:

<http://hjd.med.nyu.edu/harkness/research/research-publications>

International Association for Dance Medicine and Science (IADMS)

<http://www.iadms.org/>

Resource papers:

<http://www.iadms.org/displaycommon.cfm?an=1&subarticlenbr=186>

Links:

<http://www.iadms.org/displaycommon.cfm?an=5>

Medicine, arts medicine, and arts education organization links:

<http://www.iadms.org/displaycommon.cfm?an=1&subarticlenbr=5>

Publications:

<http://www.iadms.org/displaycommon.cfm?an=3>

Performing Arts Medicine Association (PAMA)

<http://www.artsmed.org/>

<http://www.artsmed.org/symposium.html>

Interactive bibliography site:

<http://www.artsmed.org/bibliography.html>

Related links:

<http://www.artsmed.org/relatedlinks.html>

Member publications:

<http://artsmed.org/publications.html>

***(Educators, researchers, and clinicians, please continue to email your conference and continuing education information to include in future blasts)***

## **Update on Concussions**

Concussions have become a very hot topic of research and discussion, particularly in the world of sports medicine. Dancers, gymnasts, ice skaters, acrobats and other performing artists are also at risk for concussion injury. This month's blast shares some of the most recent publications focused on diagnostic tools, recommendations for management/rehabilitation, prognosis and return to performance protocols. I have also included articles exploring aspects of brain function and physiology in

injured subjects, as well as articles sharing how concussions affect balance and even music listening capabilities. Of course, more research is needed on the management of concussion in performing artists, but using the wealth of information gathered from other sports can serve as a wonderful guide for our areas of interest in the performing arts.

*Brooke Winder, PT, DPT, OCS  
Director of Physical Therapy  
The Cypress Center, Pacific Palisades, CA*

### **Arresta B, Lamb D. Sensitivity and Specificity of the ImPACT in Determining Presence of Concussion: A Systematic Review. 2013.**

Introduction: Concussions are traumatic brain injuries typically caused by violent collisions, occurring with or without loss of consciousness and potential physical, mental, or emotional effects. Rising athletic participation is correlated with increased concussion incidence, raising the question of what screening tool is best for diagnosis and helping make return-to-play decisions. Purpose: The purpose of this systematic review was to identify the sensitivity and specificity of the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) which includes the Post-Concussion Symptom Scale (PCSS). Method: MEDLINE, Ovid, ERIC, Google Scholar, Cochrane, PubMed, CINAHL, PEDro and Science Direct were searched. Reference lists and databases were searched specifically for the ImPACT and computerized post-concussion assessment tool. Studies were examined for bias based on published recommendations. Articles were examined using the tool adapted from Jerosch-Herold & Terwee. Results: Six studies on the ImPACT were included, which were of moderate methodological quality. Each article either discussed the ImPACT exclusively or in comparison with other concussion screens/tests. When compared to other available tools, the ImPACT tested highest in regards to sensitivity and specificity. Discussion: Research was limited by the lack of available studies. The articles included limitations of author/researcher bias and methodological imperfections. Regardless, articles proved to be of enough quality to draw conclusions based on their results. Conclusions: The ImPACT test which includes the PCSS has been deemed sensitive and specific to high school and college athletes. The ImPACT is a conclusive test as compared to the gold standard of sideline screening.

### **Balzani C, Mariaud A, Schön D, Cermolacce M, Vion-Dury J. Changes in music listening in post-concussion syndrome after mild traumatic brain injury. *Psychomusicology: Music, Mind and Brain*. 2014;24(2):117.**

Mild traumatic brain injury (MTBI) has a high incidence and sometimes causes post-concussion syndrome (PCS). Modifications in music listening appear to be a complaint

of patients suffering from PCS. In this article, we characterize these changes and evaluate them using both objective and subjective data. After a complete neuropsychological, morphological, and neurophysiological evaluation, 10 patients with PCS fulfilled 2 music-specific assessments: a self-report questionnaire about changes in music listening post-MTBI, and an evaluation of musical abilities derived from the Montreal Battery of Evaluation of Amusia consisting of perception subtests, to which were added production and reproduction subtests of different aspects of music (duration, melody, rhythm...). The results were compared with those obtained in a population of healthy subjects. The patients were significantly less accurate than the controls in rhythmic performance (discrimination and reproduction of rhythms). The MTBI patients described a global change in music listening, mainly consisting of a reduction in listening, noise intolerance, and a decrease in pleasure or immersive feelings in music. They also reported subjective impairments, such as modification of time consciousness and thought suspension, which was correlated with MRI anomalies. Modifications of musical abilities may represent an underestimated consequence of MTBI, in addition to the more commonly associated impairments of high-level cognitive activities. (PsycINFO Database Record (c) 2014 APA, all rights reserved)

**Blake T, McKay C, Meeuwisse W, Emery C. The impact of concussion on cardiac autonomic function: a systematic review of evidence for recovery and prevention. *British Journal of Sports Medicine*. 2014/04/01;48(7):569.**

**Background** Concussions can negatively impact cognitive, behavioural, and physiological function. The current standard of care does not account for the physiological impact of concussion. Cardiac autonomic function (CAF) is responsive to changes in physical and cognitive exertion in healthy populations. The influence of concussion on CAF is not well understood. **Objective** To evaluate the evidence regarding the effect of concussion on cardiac autonomic function. **Design** Systematic Review. **Setting** Databases [Medline, SportDiscus, HealthSTAR, PsycINFO, Web of Science, CINAHL, Cochrane Central Register of Controlled Trials, EMBASE, PubMed and ProQuest, Web of Science and Google Scholar] were systematically searched using keywords and MeSH terms. **Sample** Inclusion criteria: original research, available in English, included participants with concussion or mild traumatic brain injury (mTBI) and had a comparison group. Studies of humans (greater than 6 years old) and animals were included. Ten articles were identified for critical appraisal (six cohort studies, four cross-sectional). **Independent variable** Diagnosis of a concussion or mTBI. **Main outcome measurements** Heart rate (HR) and/or heart rate variability (HRV). Critical appraisal was conducted using the Downs and Black criteria. **Results** There is conflicting evidence regarding CAF at rest following concussion/mTBI. There is evidence of elevated HR and reduced HRV with low intensity, steady-state exercise up to 10 days following concussion. No significant difference in HRV was found during isometric handgrip testing following concussion. The validity of current literature is limited by small sample sizes, lack of female or pediatric participants, varying methodologies and lack of follow-up. No studies evaluating CAF during cognitive exertion following concussion were found. **Conclusions** There is evidence to suggest

that CAF is altered during physical activity following concussion. The limitations in available literature highlight the need further research. Understanding the effect of concussion on CAF will contribute to the development of more comprehensive concussion management and prevention strategies.

**Brown NJ, Mannix RC, O'Brien MJ, Gostine D, Collins MW, Meehan WP, 3rd. Effect of cognitive activity level on duration of post-concussion symptoms. *Pediatrics*. Feb 2014;133(2):e299-304.**

**OBJECTIVE:** To determine the effect of cognitive activity level on duration of post-concussion symptoms. **METHODS:** We conducted a prospective cohort study of patients who presented to a Sports Concussion Clinic within 3 weeks of injury between October 2009 and July 2011. At each visit, patients completed a scale that recorded their average level of cognitive activity since the previous visit. The product of cognitive activity level and days between visits (cognitive activity-days) was calculated and divided into quartiles. Kaplan-Meier Product Limit method was used to generate curves of symptom duration based on cognitive activity level. To adjust for other possible predictors of concussion recovery, we constructed a Cox proportional hazard model with cognitive activity-days as the main predictor. **RESULTS:** Of the 335 patients included in the study, 62% were male, 19% reported a loss of consciousness, and 37% reported experiencing amnesia at the time of injury. The mean age of participants was 15 years (range, 8–23) and the mean number of previous concussions was 0.76; 39% of athletes had sustained a previous concussion. The mean Post-Concussion Symptom Scale score at the initial visit was 30 (SD, 26). The overall mean duration of symptoms was 43 days (SD, 53). Of all variables assessed, only total symptom burden at initial visit and cognitive activity level were independently associated with duration of symptoms. **CONCLUSIONS:** Increased cognitive activity is associated with longer recovery from concussion. This study supports the use of cognitive rest and adds to the current consensus opinion

**Cancelliere C, Hincapie CA, Keightley M, et al. Systematic review of prognosis and return to play after sport concussion: results of the International Collaboration on Mild Traumatic Brain Injury Prognosis. *Arch Phys Med Rehabil*. Mar 2014;95(3 Suppl):S210-229.**

**Objective:** To synthesize the best available evidence on prognosis after sport concussion. **Data Sources:** MEDLINE and other databases were searched (2001–2012) with terms including “craniocerebral trauma” and “sports.” Reference lists of eligible articles were also searched. **Study Selection:** Randomized controlled trials and cohort and case-control studies were selected according to predefined criteria. Studies had to have a minimum of 30 concussion cases. **Data Extraction** Eligible studies were critically appraised using a modification of the Scottish Intercollegiate Guidelines Network (SIGN) criteria. Two reviewers independently reviewed and extracted data from accepted studies into evidence tables. **Data Synthesis** Evidence was synthesized qualitatively according to modified SIGN criteria, and studies were categorized as exploratory or confirmatory based on the strength of their design and evidence. After 77,914 records

were screened, 52 articles were eligible for this review, and 24 articles (representing 19 studies) with a low risk of bias were accepted. Our findings are based on exploratory studies of predominantly male football players at the high school, collegiate, and professional levels. Most athletes recover within days to a few weeks, and American and Australian professional football players return to play quickly after mild traumatic brain injury. Delayed recovery appears more likely in high school athletes, in those with a history of previous concussion, and in those with a higher number and duration of postconcussion symptoms. Conclusions: The evidence concerning sports concussion course and prognosis is very preliminary, and there is no evidence on the effect of return-to-play guidelines on prognosis. Our findings have implications for further research. Well-designed, confirmatory studies are urgently needed to understand the consequences of sport concussion, including recurrent concussion, across different athletic populations and sports

**Czerniak SM, Sikoglu EM, Navarro AA, et al. A resting state functional magnetic resonance imaging study of concussion in collegiate athletes. *Brain Imaging Behav.* Aug 12 2014.**

Sports-related concussions are currently diagnosed through multi-domain assessment by a medical professional and may utilize neurocognitive testing as an aid. However, these tests have only been able to detect differences in the days to week post-concussion. Here, we investigate a measure of brain function, namely resting state functional connectivity, which may detect residual brain differences in the weeks to months after concussion. Twenty-one student athletes (9 concussed within 6 months of enrollment; 12 non-concussed; between ages 18 and 22 years) were recruited for this study. All participants completed the Wisconsin Card Sorting Task and the Color-Word Interference Test. Neuroimaging data, specifically resting state functional Magnetic Resonance Imaging data, were acquired to examine resting state functional connectivity. Two sample t-tests were used to compare the neurocognitive scores and resting state functional connectivity patterns among concussed and non-concussed participants. Correlations between neurocognitive scores and resting state functional connectivity measures were also determined across all subjects. There were no significant differences in neurocognitive performance between concussed and non-concussed groups. Concussed subjects had significantly increased connections between areas of the brain that underlie executive function. Across all subjects, better neurocognitive performance corresponded to stronger brain connectivity. Even at rest, brains of concussed athletes may have to 'work harder' than their healthy peers to achieve similar neurocognitive results. Resting state brain connectivity may be able to detect prolonged brain differences in concussed athletes in a more quantitative manner than neurocognitive test scores.

**Dettwiler A, Murugavel M, Putukian M, Cubon V, Furtado J, Osherson D. Persistent differences in patterns of brain activation after sports-related concussion: a longitudinal functional magnetic resonance imaging study. *J Neurotrauma.* Jan 15 2014;31(2):180-188.**



Avoiding recurrent injury in sports-related concussion (SRC) requires understanding the neural mechanisms involved during the time of recovery after injury. The decision for return-to-play is one of the most difficult responsibilities facing the physician, and so far this decision has been based primarily on neurological examination, symptom checklists, and neuropsychological (NP) testing. Functional magnetic resonance imaging (fMRI) may be an additional, more objective tool to assess the severity and recovery of function after concussion. The purpose of this study was to define neural correlates of SRC during the 2 months after injury in varsity contact sport athletes who suffered a SRC. All athletes were scanned as they performed an  $n$ -back task, for  $n=1, 2, 3$ . Subjects were scanned within 72 hours (session one), at 2 weeks (session two), and 2 months (session three) post-injury. Compared with age and sex matched normal controls, concussed subjects demonstrated persistent, significantly increased activation for the 2 minus 1  $n$ -back contrast in bilateral dorsolateral prefrontal cortex (DLPFC) in all three sessions and in the inferior parietal lobe in session one and two ( $\alpha \leq 0.01$  corrected). Measures of task performance revealed no significant differences between concussed versus control groups at any of the three time points with respect to any of the three  $n$ -back tasks. These findings suggest that functional brain activation differences persist at 2 months after injury in concussed athletes, despite the fact that their performance on a standard working memory task is comparable to normal controls and normalization of clinical and NP test results. These results might indicate a delay between neural and behaviorally assessed recovery after SRC.

**Giza CC, Kutcher JS, Ashwal S, et al. Summary of evidence-based guideline update: evaluation and management of concussion in sports: report of the Guideline Development Subcommittee of the American Academy of Neurology. *Neurology*. Jun 11 2013;80(24):2250-2257.**

Objective: To update the 1997 American Academy of Neurology practice parameter regarding the evaluation and management of sports concussion, with a focus on four questions: 1) For athletes what factors increase or decrease concussion risk? 2) For athletes suspected of having sustained concussion, what diagnostic tools are useful in identifying those with concussion and those at increased risk for severe or prolonged early impairments, neurologic catastrophe, or chronic neurobehavioral impairment? 3) For athletes with concussion, what clinical factors are useful in identifying those at increased risk for severe or prolonged early postconcussion impairments, neurologic catastrophe, recurrent concussions, or chronic neurobehavioral impairment? (4) For athletes with concussion, what interventions enhance recovery, reduce the risk of recurrent concussion, or diminish long-term sequelae? Methods: A systematic review of the literature from 1955–June 2012 for pertinent evidence was performed. Evidence was assessed for quality and synthesized into conclusions by use of a modified form of the process. Recommendations were developed using a modified Delphi process. Results: 1) Specific risk factors increase (type of sport – football, rugby) or decrease (type of sport – baseball, softball, volleyball, and gymnastics; rugby helmet use) the risk of concussion. 2) Diagnostic tools useful to identify those with concussion include graded symptom checklists, Standardized Assessment of Concussion,

neuropsychological testing (paper-and-pencil and computerized), and the Balance Error Scoring System. 3) Ongoing clinical symptoms, history of prior concussions, and younger age identify those at risk for prolonged postconcussion impairments. Risk factors for recurrent concussion include having a history of multiple concussions and being within 10 days after an initial concussion. Risk factors for chronic neurobehavioral impairment include concussion exposure and epsilon4 genotype. 4) There is insufficient evidence to show that any intervention enhances recovery or diminishes long-term sequelae after a sports-related concussion. Nineteen evidence-based recommendations were developed in 3 categories: preparticipation counseling, assessment and management of suspected concussion, and management of diagnosed concussion.

**Heyworth BE, Carroll KM, Rizza AJ, McInnis KC, Gill TJ. Treatment of concussion in high school athletes: a proposed protocol for athletic and academic return to activity. *Orthopaedic Journal of Sports Medicine*. 2014;2(2 suppl).**

**Objectives:** Growing evidence suggests that there may be significant long term sequelae of cumulative concussions, which may include prolonged cognitive deficits and physical symptoms. There are a growing number of concussions each year in high school athletes that occur during sports. The objective of this study is to investigate the impact of cerebral concussions on athletes to gain a deeper understanding of sports related cerebral concussions that will ultimately lead to development of better management and prevention strategies. The hypothesis of the current study is that adolescent athletes who suffer from sports-related concussions demonstrate neurocognitive and neuropsychological deficits that affect both athletic and academic performance. To date, no current guidelines exist for return to academic activities, such as classroom attendance and schoolwork.

**Methods:** A review of prospectively collected data of all student athletes who suffered a concussion during athletics in a single high school from 2006 to 2010. The following validated patient-reported outcome scores were used to assess function and symptom scores pre- and post-injury: Impact Score, and SAC score. Concussed athletes completed baseline and post injury Immediate Post-concussion Assessment and Cognitive Test (ImPACT), and SAC testing on the same day. Athletes then followed the Zurich consensus guidelines for RTP. Documented concussions were categorized by time missed from participation using severity outcome intervals (same-day return, 1- to 2-day return, 3- to 6-day return, 7- to 9-day return, 10- to 21-day return, >21-day return, no return). All clinical notes from a single athletic trainer were reviewed for each athlete. The clinical data collected included patient demographics, history of concussions/migraine headaches/ depression/ anxiety, current concussion components, sideline (SAC) and computer-based (ImPact) neurocognitive testing, physical exertion post-concussion, and the total number of days to return to play.

**Results:** There were 120 concussions that occurred during athletics in a single high school between 2006 and 2011. There were 104 athletes (107 concussions) included in our study (64 males, 40 females). The average age at time of injury was  $16 \pm 1.24$  years (Range 14-20). There were 62 injuries with an on Field SAC exam (Average  $25 \pm 3$ ), 81 patients had a SAC exam 1 day after injury, 43 patients had both on field and post day 1 injury SAC exams (Mean Difference in scores  $3 \pm 4$ ). The average time until asymptomatic was 20 (Range 4-147) days, and average time for RTP was 39 (Range 6-147) days. In this cohort of high school athletes, RTP within the first week after concussion was unlikely. There were 7 athletes who had documented academic accommodations.

**Conclusion:** Athletes that suffered a concussion during athletic play were unlikely to return to sports in less than a week. We found the Zurich consensus exertion protocol was important to differentiate athletes that were asymptomatic at rest, but had return of symptoms with exertional stress. Based on these results athletes were able to safely return to play without re-injury once the SAC and ImPACT test returned to baseline. In addition, athletes subjectively had an improvement in symptoms when academic accommodations were instituted as well.

**Howell DR, Osternig LR, Chou LS. Return to Activity after Concussion Affects Dual-Task Gait Balance Control Recovery. *Med Sci Sports Exerc.* Aug 5 2014.**

**BACKGROUND:** Recent work has identified deficits in dual-task gait balance control for up to 2 months following adolescent concussion, however how resumption of pre-injury physical activities affects recovery is unknown.

**PURPOSE:** To examine how return to activity affects recovery from concussion on measures of symptom severity, cognition, and balance control during single-task and dual-task walking. **METHODS:** Nineteen adolescents with concussion who returned to pre-injury activity within 2 months following injury and 19 uninjured, matched controls completed symptom inventories, computerized cognitive testing, and single-task and dual-task gait analyses. Concussion participants were assessed at 5 time points: within 72 hours, one week, two weeks, one month, and two months post-injury. Control participants were assessed at the same time points as their matched concussion counterparts. Return-to-activity (RTA) day was documented as the post-injury day which physical activity participation was allowed. The effect of returning to physical activity was assessed by examining the percent change on each dependent variable across time prior to and directly after the RTA. Data were analyzed by two-way mixed effects ANOVAs. **RESULTS:** Following the RTA day, concussion participants significantly increased their total center-of-mass medial/lateral displacement ( $p=.009$ ,  $\eta p = .175$ ) and peak velocity ( $p=.048$ ,  $\eta p = .104$ ) during dual-task walking, when compared to pre RTA data, while no changes for the concussion group or between groups were detected on measures of single-task walking, forward movement, or cognition. **CONCLUSIONS:** Adolescents with

concussion displayed increased center-of-mass medial/lateral displacement and velocity during dual-task walking following RTA, suggesting a regression of recovery in gait balance control. This study reinforces the need for a multi-faceted approach to concussion management and continued monitoring beyond the point of clinical recovery

**King D, Brughelli M, Hume P, Gissane C. Assessment, management and knowledge of sport-related concussion: systematic review. *Sports Med.* Apr 2014;44(4):449-471.**

Background: Sport-related concussions are a subset of mild traumatic brain injuries and are a concern for many sporting activities worldwide. Objective: To review and update the literature in regard to the history, pathophysiology, recognition, assessment, management and knowledge of concussion. Methods: Searches of electronic literature databases were performed to identify studies published up until April 2013. Results: 292 publications focussing on concussion met the inclusion criteria, and so they were quality rated and reviewed. Conclusion: Concussion is hard to recognize and diagnose. Initial sideline assessment via the Sports Concussion Assessment Tool 3 (SCAT3), Child-SCAT3 or King-Devick test should be undertaken to identify athletes with concussion as part of a continuum of assessment modalities and athlete management. Sports medicine practitioners should be cognisant of the definition, extent and nature of concussion, and should work with coaches, athletes and trainers to identify and manage concussions. The most common reason for variations in management of concussion is lack of awareness of—and confusion about—the many available published guidelines for concussion. Future research should focus on better systems and tools for recognition, assessment and management of concussion. Sport participants' knowledge of concussion should be evaluated more rigorously, with interventions for sports where there is little knowledge of recognition, assessment and appropriate management of concussion.

**Kontos AP, Huppert TJ, Beluk NH, et al. Brain activation during neurocognitive testing using functional near-infrared spectroscopy in patients following concussion compared to healthy controls. *Brain Imaging Behav.* Jan 30 2014.**

There is no accepted clinical imaging modality for concussion, and current imaging modalities including fMRI, DTI, and PET are expensive and inaccessible to most clinics/patients. Functional near-infrared spectroscopy (fNIRS) is a non-invasive, portable, and low-cost imaging modality that can measure brain activity. The purpose of this study was to compare brain activity as measured by fNIRS in concussed and age-matched controls during the performance of cognitive tasks from a computerized neurocognitive test battery. Participants included nine currently symptomatic patients aged 18–45 years with a recent (15–45 days) sport-related concussion and five age-matched healthy controls. The participants completed a computerized neurocognitive test battery while wearing the fNIRS unit. Our results demonstrated reduced brain activation in the concussed subject group during word memory, (spatial) design memory, digit-symbol substitution (symbol match), and working memory (X's and O's)

tasks. Behavioral performance (percent-correct and reaction time respectively) was lower for concussed participants on the word memory, design memory, and symbol match tasks than controls. The results of this preliminary study suggest that fNIRS could be a useful, portable assessment tool to assess reduced brain activation and augment current approaches to assessment and management of patients following concussion.

**May KH, Marshall DL, Burns TG, Popoli DM, Polikandriotis JA. Pediatric sports specific return to play guidelines following concussion. *Int J Sports Phys Ther.* Apr 2014;9(2):242-255.**

**Purpose/Background:**In 2010, the American Academy of Pediatrics officially adopted the recommended return to play guidelines proposed by the International Conference on Concussion in Sport. The guidelines include a six-step process that provides structure to guide an athlete who is recovering from a concussion in a gradual return to play (RTP) by allowing participation in increasingly difficult physical activities. Unfortunately, the guidelines fail to take into account the variability that occurs within different sports and the resulting challenges medical professionals face in making sure each athlete is able to withstand the rigors of their specific sport, without return of symptoms. Therefore, the purpose of this clinical commentary is to expand upon the current general consensus guidelines for treatment of concussed pediatric athletes and provide sport specific RTP guidelines.

**Description of Topic:**The intention of the sport specific guidelines is to maintain the integrity of the current six-step model, add a moderate activity phase highlighted by resistance training, and to provide contact and limited contact drills specific to the athlete's sport and/or position. The drills and activities in the proposed seven-step programs are designed to simulate sport specific movements; the sports include: football, gymnastics, cheerleading, wrestling, soccer, basketball, lacrosse, baseball, softball, and ice hockey. These activities will provide sports specific challenges to each athlete while simultaneously accomplishing the objectives of each stage of the RTP progression. The final RTP determination should occur with documented medical clearance from a licensed healthcare provider who has been trained in the evaluation and management of concussions.

**Discussion/Relation to Clinical Practice:** There have been significant strides in the management and care of concussed athletes. However, there continues to be a lot of confusion among, athletes, parents, and coaches regarding the proper management of an athlete with a concussion, particularly in the pediatric population. In an effort to eliminate ambiguity and help further promote adherence to the RTP guidelines, the authors developed several sports-specific RTP guidelines.

**Schneider KJ, Meeuwisse WH, Nettel-Aguirre A, et al. Cervicovestibular rehabilitation in sport-related concussion: a randomised controlled trial. *Br J Sports Med.* Sep 2014;48(17):1294-1298.**

**Background/aim** Concussion is a common injury in sport. Most individuals recover in 7–10 days but some have persistent symptoms. The objective of this study was to determine if a combination of vestibular rehabilitation and cervical spine physiotherapy

decreased the time until medical clearance in individuals with prolonged postconcussion symptoms. **Methods** This study was a randomised controlled trial. Consecutive patients with persistent symptoms of dizziness, neck pain and/or headaches following a sport-related concussion (12–30 years, 18 male and 13 female) were randomised to the control or intervention group. Both groups received weekly sessions with a physiotherapist for 8 weeks or until the time of medical clearance. Both groups received postural education, range of motion exercises and cognitive and physical rest until asymptomatic followed by a protocol of graded exertion. The intervention group also received cervical spine and vestibular rehabilitation. The primary outcome of interest was medical clearance to return to sport, which was evaluated by a study sport medicine physician who was blinded to the treatment group. **Results** In the treatment group, 73% (11/15) of the participants were medically cleared within 8 weeks of initiation of treatment, compared with 7% (1/14) in the control group. Using an intention to treat analysis, individuals in the treatment group were 3.91 (95% CI 1.34 to 11.34) times more likely to be medically cleared by 8 weeks. **Conclusions** A combination of cervical and vestibular physiotherapy decreased time to medical clearance to return to sport in youth and young adults with persistent symptoms of dizziness, neck pain and/or headaches following a sport-related concussion.

**Stein CJ, Kinney SA, McCrystal T, et al. Dance-related concussion: a case series. *J Dance Med Sci.* 2014;18(2):53-61.**

Sport-related concussion is a topic of increasing public and media attention; the medical literature on this topic is growing rapidly. However, to our knowledge no published papers have described concussion specifically in the dancer. This case series involved a retrospective chart review at a large teaching hospital over a 5.5-year period. Eleven dancers (10 female, 1 male) were identified who experienced concussions while in dance class, rehearsal, or performance: 2 in classical ballet, 2 in modern dance, 2 in acro dance, 1 in hip hop, 1 in musical theater, and 3 were unspecified. Dancers were between 12 and 20 years old at the time of presentation. Three concussions occurred during stunting, diving, or flipping. Three resulted from unintentional drops while partnering. Two followed slips and falls. Two were due to direct blows to the head, and one dancer developed symptoms after repeatedly whipping her head and neck in a choreographed movement. Time to presentation in the sports medicine clinic ranged from the day of injury to 3 months. Duration of symptoms ranged from less than 3 weeks to greater than 2 years at last documented follow-up appointment. It is concluded that dancers do suffer dance-related concussions that can result in severe symptoms, limitations in dance participation, and difficulty with activities of daily living. Future studies are needed to evaluate dancers' recognition of concussion symptoms and care-seeking behaviors. Additional work is also necessary to tailor existing guidelines for gradual, progressive, safe return to dance.

**West TA, Marion DW. Current recommendations for the diagnosis and treatment of concussion in sport: a comparison of three new guidelines. *J Neurotrauma.* Jan 15 2014;31(2):159-168.**

Currently, there is considerable debate within the sports medicine community about the role of concussion and the risk of chronic neurological sequelae. This concern has led to significant confusion among primary care providers and athletic trainers about how to best identify those athletes at risk and how to treat those with concussion. During the first quarter of 2013, several new or updated clinical practice guidelines and position statements were published on the diagnosis, treatment, and management of mild traumatic brain injury/concussion in sports. Three of these guidelines were produced by the American Medical Society for Sports Medicine, The American Academy of Neurology, and the Zurich Consensus working group. The goal of each group was to clearly define current best practices for the definition, diagnosis, and acute and post-acute management of sports-related concussion, including specific recommendations for return to play. In this article, we compare the recommendations of each of the three groups, and highlight those topics for which there is consensus regarding the definition of concussion, diagnosis, and acute care of athletes suspected of having a concussion, as well as return-to-play recommendations.

