PERFORMING ARTS
SPECIAL INTEREST GROUP

ORTHOPAEDIC SECTION
AMERICAN PHYSICAL THERAPY ASSOCIATION

APTA
American Physical Therapy Association
The Science of Healing. The Art of Caring.

PASIG MONTHLY CITATION BLAST: No.59 **April 2011**

Dear PASIG members:

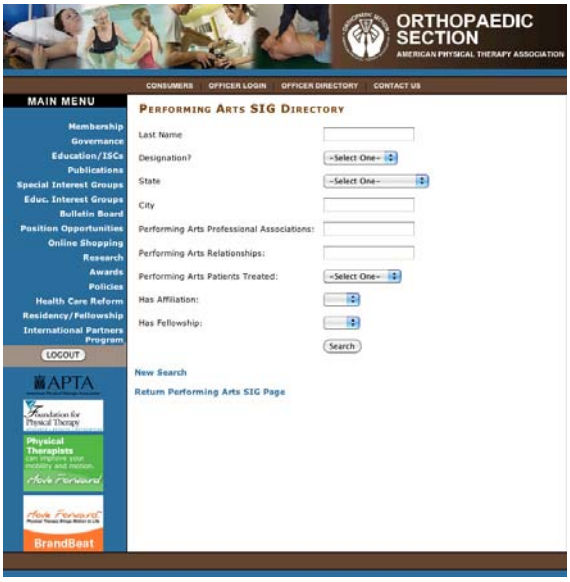
The time is here to start developing your PA abstracts for submission to CSM 2012 in Chicago. Abstract submission deadline is 6/06/11. To submit, go to: http://apta-csm2012.abstractcentral.com/

This will be my last year as PASIG Research Chair and writing these Blasts. If you are interested in stepping up to serve, please contact our Nominating Committee Chair, Kendra Gage, e-mail: Kgage@athletico.com. It's time for new ideas and I look forward to supporting our next Chair. I appreciate the contributions made by our members to these Blasts, as programming speakers, and through presentation of your PA research.

If you haven't perused the PASIG Website lately, you might be missing some vital information. There is a wealth of information located there including:

- Archived monthly citation blasts, by date and topic
- Officer directory
- Member Directory with an advanced search
- Meeting minutes from our annual meetings at CSM
- Member profile update to provide detailed information about your PA experience, relationships, practice information
- A list of clinical affiliations
- A list of Entry-level PT Programs With a Strong Performing Arts Curriculum
- Performing Arts Glossaries: Ballet, Figure Skating, Artistic Gymnastics, and Hip Hop Dance
- Information regarding the PASIG Student Scholarship
- Technical report from the PASIG practice analysis
- A bulletin board to ask questions

The PASIG needs members to complete our membership survey in order to update your profile. This is a valuable resource for colleagues who may have traveling artists in need of a physical therapist in a new location. You can fill this out online at the following address once you've logged in as an Orthopaedic Section member: https://www.orthopt.org/surveys/membership_directory.php



Also, if you haven't already done so, please contact Kendra Gage (kmhgage@gmail.com) if you have a PA student clinical affiliation. She will need to know the following:

- Name of Practice
- Address
- Clinical coordinator
- Phone
- Fax
- E-mail
- % PA treated and type of artist
- Student requirements

PERFORMING ARTS CONTINUING EDUCATION OPPORTUNITIES

****Performing Arts Independent Study Couses****

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

Orthopaedic Section Independent Study Course. *Dance Medicine: Strategies for the Prevention and Care of Injuries to Dancers*.

This is a 6-monograph course and includes many PASIG members as authors.

- Epidemiology of Dance Injuries: Biopsychosocial Considerations in the Management of Dancer Health (MJ Liederbach),
- Nutrition, Hydration, Metabolism, and Thinness (B Glace),
- The Dancer's Hip: Anatomic, Biomechanical, and Rehabilitation Considerations (G. Grossman),
- Common Knee Injuries in Dance (MJ Liederbach),
- Foot and Ankle Injuries in the Dancer: Examination and Treatment Strategies (M. Molnar, R. Bernstein, M. Hartog, L. Henry, M. Rodriguez, J. Smith, A. Zujko),
- Developing Expert Physical Therapy Practice in Dance Medicine – (J. Gamboa, S. Bronner, TJ Manal).

Contact: Orthopaedic Section at: www.orthopt.org

American Osteopathic Association of Sports Medicine (AOASM) 26th Annual Conference 2011

"Performing Arts"
April 27, 2011
This year's conference theme is "Performing Arts," and AOASM is proud to be the first American medical organization to devote an entire conference to this growing population. The first day is called Strictly Dancing, during which several of the world's top experts will speak about various forms of dance, stress injuries, spinal conditions, and keeping dancers mentally healthy. The afternoon will get you hands-on in the dancer world, with workshops in physical exams, movement, core, and taping sessions.
But there's more to performing arts than just dance. Lecture modules will discuss roller derby, professional wrestling, figure skating, and gymnastics. Saturday lectures break down into two themes: the Price of Performance and Enhancing Performance. Topics will include osteoporosis, end-stage hip disease, psycho- social disorders, mental preparation, nutritional treatment of inflammation, and alternative treatments. We will lso feature a module on lacrosse, a lecture update on concussion, and workshops on emergency medicine and osteopathic manipulative medicine.
Register today to support continued education and development in performing arts medicine and provide quality care to your dancers!
Location: Providence, Rhode Island, USA at the Westin Providence Hotel Register: www.aoasm.org

1st Dance Medicine and Science Conference in Luxembourg City
An IADMS/Trinity College London *Safe and Effective Dance Practice* information day
May 29, 2011
Organizers: Dance Science Net, VEDANZA. Hosts: Danz Festival Letzëbuerg **Support:** Fondation Eté under the aegis of Fondation de Luxembourg, Cercle Cité, Ville de Luxembourg, Danz Festival Letzebuerg, Harlequin, Trinity College London.
This conference addresses all dance related professionals, including physicians, physiotherapists, movement specialists, alternative healthcare practitioners, company directors, choreographers, teachers, and dancers and is dedicated to improving dancers' health, well-being, and performance by promoting safe and effective dance practice, body/mind friendly training, and injury prevention strategies. Topics will include fitness, eating disorders, psychological and physical issues in training today, hyper-mobility, turnout, imagery and somatic training, breathing, core stability, abdominal strength, and injury prevention and management. Information will also be provided about the IADMS/Trinity College London *Certificate in Safe and Effective Dance Practice* and the conference's content will provide valuable learning for those wishing to take this qualification.
The conference will be hosted during the Danz Festival Letzebuerg, a contemporary platform for local and international dance companies in the charming and picturesque capital city of the Grand Duchy of Luxembourg.
Contacts: Emanuela Iacopini (conference organizer) info@dancescience.net (+352) 621 176263 Eugenia Bianco (conference coordinator) conference@dancescience.net

Please send information about other courses of interest to our membership to: Amy Humphrey PT, DPT, OCS, MTC; ahumphrey@Bodydynamicsinc.com

For this April Citation BLAST, Jeff Stenback has have selected the topic "*Concussions."* Management of concussions in sports is all over the news in the past year. What is the policy of the performing arts (PA) group that you work with? If you have a policy modified for PA, please share it with us by sending it to Jeff or myself. We'd like to follow up on this topic. The format is an annotated bibliography of articles from 2001 – 2011. The PASIG Research Committee initiated this monthly Citation BLAST on performing arts-related topics in June 2005 in the hopes of encouraging our members to stay current in the literature and, perhaps, consider conducting research themselves. Each month we send a new list of performing arts (PA) citations to members of the PASIG to further the pursuit of PA-related scholarship. (Information about EndNote referencing software can be found at http://www.endnote.com, including a 30-day free trial).

As always, your comments, suggestions, and entry contributions to these Citation BLASTs are welcome. Please drop me an e-mail anytime.

Regards,
Shaw

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Post-concussion Assessment

Recently, we had a couple of dancers who were involved in a fairly severe motor vehicle accident on their way to the theatre. While they walked away from the incident, later that same day they were allowed to dance in a full performance against the better judgment of the on-site physical therapist. We realized that a post-concussion protocol was necessary. In speaking with a few other performing arts PTs and listening to their own stories of dancers who have fallen or have been dropped and/or hit their heads, it solidified the need to cover this important topic. As expected, much of the literature is sports-related and we each need to think about how the current sideline assessments can be modified slightly for performing arts activities (e.g. the Maddocks score). The McCrory, et al. article covering the 2nd International Conference on Concussion in Sport (2005) includes a copy of a SCAT assessment. A subsequent SCAT2 assessment was published in 2009 as a result of a 3rd International Consensus meeting in 2008 (this can be found on-line). Regarding our roles as rehab professionals or as first responders, we all need to be aware of the potential for both medical and legal issues surrounding the identification and proper management of concussions.

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Asplund CA, McKeag DB, Olsen CH (2004). Sport-related concussion: factors associated with prolonged return to play. Clin J Sport Med, 14(6):339-43.
OBJECTIVE: To assess predictive value of concussion signs and symptoms based on return-to-play timelines.DESIGN: Physician practice study without diagnosis that includes presentation, initial and subsequent treatment, and management of concussion. SETTING: National multisite primary care sports medicine provider locations.

PARTICIPANTS: Twenty-two providers at 18 sites; 101 athletes (91 men, 10 women in the following sports: 73 football, 8 basketball, 8 soccer, 3 wrestling, 2 lacrosse, 2 skiing, 5 others; 51 college, 44 high school, 4 professional, and 2 recreational). MAIN OUTCOME MEASUREMENTS: Duration of symptoms, presence of clinical signs, and time to return to play following concussion. RESULTS: One hundred one concussions were analyzed. Pearson chi2 analysis of common early and late concussion symptoms revealed statistical significance ($P < 0.05$) of headache >3 hours, difficulty concentrating >3 hours, any retrograde amnesia or loss of consciousness, and return to play >7 days. There appeared to be a trend in patients with posttraumatic amnesia toward poor outcome, but this was not statistically significant. CONCLUSIONS: When evaluating concussion, symptoms of headache >3 hours, difficulty concentrating >3 hours, retrograde amnesia, or loss of consciousness may indicate a more severe injury or prolonged recovery; great caution should be exercised before returning these athletes to play.

Bailes JE, Cantu RC (2001). Head injury in athletes. Neurosurgery, 48(1):26-45; discussion 45-6.

HEAD INJURIES INCURRED during athletic endeavors have been recorded since games were first held. During the last century, our level of understanding of the types of cerebral insults, their causes, and their treatment has advanced significantly. Because of the extreme popularity of sports in the United States and worldwide, the implications of athletic head injury are enormous. This is especially true considering the current realization that mild traumatic brain injury (MTBI) or concussion represents a major health consideration with more long-ranging effects than previously thought. When considering athletic injuries, people who engage in organized sports, as well as the large number of people who engage in recreational activities, should be considered. There are 200 million international soccer players, a group increasingly recognized to be at risk for MTBI. The participation in contact sports of a large number of the population, especially youth, requires a careful and detailed analysis of injury trends and recommended treatment. There are numerous characteristics of this patient population that make management difficult, especially their implicit request to once again be subjected to potential MTBI by participating in contact sports. Recent research has better defined the epidemiological issues related to sports injuries involving the central nervous system and has also led to classification and management paradigms that help guide decisions regarding athletes' return to play. We currently have methods at our disposal that greatly assist us in managing this group of patients, including improved recognition of the clinical syndromes of MTBI, new testing such as neuropsychological assessment, radiographic evaluations, and a greater appreciation of the pathophysiology of concussive brain injury. The potential for long-term consequences of repetitive MTBI has been recognized, and we no longer consider the "dinged" states of athletic concussions to have the benign connotations they had in the past. We review the historical developments in the recognition and care of athletes with head injuries, the current theory of the pathophysiology and biomechanics of these insults, and the recommended management strategy, including return-to-play criteria.

Broglio SP, Macciocchi SN, Ferrara MS (2007). Sensitivity of the concussion assessment battery. Neurosurgery, 60(6):1050-7; discussion 1057-8.

OBJECTIVE: Sports medicine clinicians commonly use multiple tests when evaluating patients with concussion. The specific tests vary but often include symptom inventories, posturography, and neurocognitive examinations. The sensitivity of these tests to concussion is vital in reducing the risk for additional injury by prematurely returning an athlete to play. Our study investigated the sensitivity of concussion-related symptoms, a postural control evaluation, and neurocognitive functioning in concussed collegiate athletes. METHODS: From 1998 to 2005, all high-risk athletes completed a baseline concussion-assessment battery that consisted of a self-reported symptom inventory, a postural control

evaluation, and a neurocognitive assessment. Postconcussion assessments were administered within 24 hours of injury to 75 athletes who had physician-diagnosed concussion. Individual tests and the complete battery were evaluated for sensitivity to concussion. RESULTS: The computerized Immediate Post-Concussion Assessment and Cognitive Testing and HeadMinder Concussion Resolution Index (neurocognitive tests) were the most sensitive to concussion (79.2 and 78.6%, respectively). These tests were followed by self-reported symptoms (68.0%), the postural control evaluation (61.9%), and a brief pencil-and-paper assessment of neurocognitive function (43.5%). When the complete battery was assessed, sensitivity exceeded 90%. CONCLUSION: Currently recommended concussion-assessment batteries accurately identified decrements in one or more areas in most of the athletes with concussion. These findings support previous recommendations that sports-related concussion should be approached through a multifaceted assessment with components focusing on distinct aspects of the athlete's function.

Cameron KL, Yunker CA, Austin MC (1999). A standardized protocol for the initial evaluation and documentation of mild brain injury. J Athl Train, 34(1):34-42.

OBJECTIVE: To present a protocol for the initial assessment and documentation of mild brain injury, a protocol that is used within the Department of Physical Education at the United States Military Academy. BACKGROUND: Recently, much attention has been given to the assessment and management of mild brain injury by the sports medicine community. Although the classification of and management strategies for mild brain injury have been well disputed, most experts agree on the essentials of the sideline or initial evaluation. According to leading experts, if an athlete has experienced an episode of mild brain injury, the initial signs and symptoms, as well as the course of those signs and symptoms, should be documented. DESCRIPTION: Although many athletic training texts formerly discussed techniques for evaluating an episode of mild brain injury, few present an objective protocol to follow. Our protocol includes 3 components. The first component is the initial evaluation, which incorporates serial observations during the first 20 minutes after injury, with neurologic checks every 5 minutes. The second component includes a take-home sheet for athletes not referred to a physician for further evaluation. The third part of the protocol is a 24-hour postinjury follow-up examination for any signs or symptoms of postconcussion syndrome. Finally, we present the indications for referral to a physician for further evaluation. CLINICAL ADVANTAGES/RECOMMENDATIONS: Using a standard protocol to guide evaluation and to document the initial course of signs and symptoms after mild brain injury allows the sports medicine staff to make better management decisions. In addition, patient instructions and the course of follow-up evaluations can be improved if a standard protocol is employed. Our protocol has been developed to meet the needs both of athletes who are exposed to mild brain injury on a daily basis and of the certified athletic trainers who initially evaluate them; the protocol can be adapted to the individual needs of each athletic training setting.

Covassin T, Elbin RJ, Nakayama Y (2010). Tracking neurocognitive performance following concussion in high school athletes. Phys Sportsmed, 38(4):87-93.

Objective: To extend previous research designs and examine cognitive performance up to 30 days postconcussion. Methods: A prospective cohort design was used to examine 2000 athletes from 8 mid-Michigan area high schools to compare baseline neurocognitive performance with postconcussion neurocognitive performance. All concussed athletes were readministered the Immediate Post Assessment and Cognitive Test (ImPACT) at 2, 7, 14, 21, and 30 days postconcussion. Results: A total of 72 high school athletes (aged 15.8 ± 1.34 years) sustained a concussion. A significant within-subjects effect for reaction time ($F = 10.01$; $P = 0.000$), verbal memory ($F = 3.05$; $P = 0.012$), motor processing speed ($F = 18.51$; $P = 0.000$), and total symptoms following an injury ($F = 16.45$; $P = 0.000$) was found. Concussed athletes demonstrated a significant decrease in reaction time up to 14 days postconcussion ($P = 0.001$) compared with baseline reaction time. Reaction time returned to

baseline levels at 21 days postinjury (P = 0.25). At 7 days postinjury, impairments in verbal memory (P = 0.003) and motor processing speed (P = 0.000) were documented and returned to baseline levels by 14 days postinjury. Concussed athletes self-reported significantly more symptoms at 2 days postconcussion (P = 0.000) and exhibited a resolution of symptoms by 7 days postinjury (P = 0.06). Conclusion: High school athletes could take up to 21 days to return to baseline levels for reaction time. These data support current recommendations for the conservative management of concussion in the high school athlete.

Eckner JT, Kutcher JS (2010). Concussion symptom scales and sideline assessment tools: a critical literature update. Curr Sports Med Rep, 9(1):8-15.

Sports-related concussion remains a diagnostic and management challenge for the sports medicine practitioner. Numerous symptom scales and sideline assessment tools are available for team physicians and athletic trainers to objectively assess this difficult injury. The purpose of this article is to update the reader on literature published within the past year relevant to concussion symptom scales and sideline assessment tools. A critical evaluation of pertinent articles is presented. We conclude that multiple symptom scales and assessment tools are available, with no single tool showing clear superiority. Many tools remain based more on expert opinion than rigorous scientific evaluation. A multifaceted approach to sports concussion is advised. The sports medicine practitioner must not rely on any one tool in managing concussion and must be aware of the strengths and limitations of whichever method is chosen to incorporate into a concussion evaluation and management plan.

Ellemberg D, Henry LC, Macciocchi SN, Guskiewicz KM, Broglio SP (2009). Advances in sport concussion assessment: from behavioral to brain imaging measures. J Neurotrauma, 26(12):2365-82.

Given that the incidence of sports-related concussion is considered to have reached epidemic proportions, in the past 15 years we have witnessed an explosion of research in this field. The purpose of the current review is to compare the results provided by the different assessment tools used in the scientific literature in order to gain a better understanding of the sequelae and recovery following a concussion. Until recently, the bulk of the has literature focused on the immediate outcome in the hours and days post-injury as a means to plan the safest return-to-play strategy. This has led to the development of several assessment batteries that are relatively easy and rapid to administer and that allow for multiple testing sessions. The main conclusion derived from that literature is that cognitive symptoms tend to resolve within 1 week. However, accumulating evidence indicates that cognitive testing should be viewed as one of several complementary tools necessary for a comprehensive assessment of concussion. Including an objective measure of postural stability increases the sensitivity of the return-to-play decision-making process and minimizes the consequences of mitigating factors (e.g., practice effects and motivation) on neuropsychological test results. This is consistent with findings that symptom severity, neuropsychological function, and postural stability do not appear to be related or affected to the same degree after a concussion. Furthermore, recent evidence from brain imaging, including event-related potentials and functional and metabolic imaging, suggest abnormalities in the electrical responses, metabolic balance, and oxygen consumption of neurons that persist several months after the incident. We explain this apparent discrepancy in recovery by suggesting an initial and rapid phase of functional recovery driven by compensatory mechanisms and brain plasticity, which is followed by a prolonged neuronal recovery period during which subtle deficits in brain functioning are present but not apparent to standard clinical assessment tools.

Erlanger D, Kaushik T, Cantu R, Barth JT, Broshek DK, Freeman JR, Webbe FM (2003). Symptom-based assessment of the severity of a concussion. J Neurosurg, 98(3):477-84.

OBJECT: Current grading systems of concussion and return-to-play guidelines have little empirical support. The authors therefore examined the relationships of the characteristics and symptoms of concussion and the history of concussion to three indicators of concussion severity-number of immediate symptoms, number of symptoms at the initial follow-up examination, and duration of symptoms--to establish an empirical basis for grading concussions. METHODS: Forty-seven athletes who sustained concussions were administered alternate forms of an Internet-based neurocognitive test until their performances were within normal limits relative to baseline levels. Assessments of observer-reported and self-reported symptoms at the sideline of the playing field on the day of injury, and at follow-up examinations were also obtained as part of a comprehensive concussion management protocol. Although loss of consciousness (LOC) was a useful indicator of the initial severity of the injury, it did not correlate with other indices of concussion severity, including duration of symptoms. Athletes reporting memory problems at follow-up examinations had significantly more symptoms in general, longer durations of those symptoms, and significant decreases in scores on neurocognitive tests administered approximately 48 hours postinjury. This decline of scores on neurocognitive testing was significantly associated with an increased duration of symptoms. A history of concussion was unrelated to the number and duration of symptoms. CONCLUSIONS: This paper represents the first documentation of empirically derived indicators of the clinical course of postconcussion symptom resolution. Self-reported memory problems apparent 24 hours postconcussion were robust indicators of the severity of sports-related concussion and should be a primary consideration in determining an athlete's readiness to return to competition. A decline on neurocognitive testing was the only objective measure significantly related to the duration of symptoms. Neither a brief LOC nor a history of concussion was a useful predictor of the duration of postconcussion symptoms.

Evans RW (1992). The postconcussion syndrome and the sequelae of mild head injury. Neurol Clin, 10(4):815-47.

The postconcussion syndrome refers to a large number of symptoms and signs that may occur alone or in combination following usually mild head injury. The most common complaints are headaches, dizziness, fatigue, irritability, anxiety, insomnia, loss of consciousness and memory, and noise sensitivity. Mild head injury is a major public health concern because the annual incidence is about 150 per 100,000 population, accounting for 75% or more of all head injuries. The postconcussion syndrome has been recognized for at least the last few hundred years and has been the subject of intense controversy for more than 100 years. The Hollywood head injury myth has been an important contributor to persisting skepticism and might be countered by educational efforts and counter-examples from boxing. The organicity of the postconcussion syndrome has now become well documented. Abnormalities following mild head injury have been reported in neuropathologic, neurophysiologic, neuroimaging, and neuropsychologic studies. There are multiple sequelae of mild head injury, including headaches of multiple types, cranial nerve symptoms and signs, psychologic and somatic complaints, and cognitive impairment. Rare sequelae include hematomas, seizures, transient global amnesia, tremor, and dystonia. Neuroimaging and physiologic and psychologic testing should be used judiciously based on the problems of the particular patient rather than in a cookbook fashion. Prognostic studies clearly substantiate the existence of a postconcussion syndrome. Manifestations of the postconcussion syndrome are common, with resolution in most patients by 3 to 6 months after the injury. Persistent symptoms and cognitive deficits are present in a distinct minority of patients for additional months or years. Risk factors for persisting sequelae include age over 40 years; lower educational, intellectual, and socioeconomic level; female gender; alcohol abuse; prior head injury; and multiple trauma. Although a small minority are

malingerers, frauds, or have compensation neurosis, most patients have genuine complaints. Contrary to a popular perception, most patients with litigation or compensation claims are not cured by a verdict. Treatment is individualized depending on the specific complaints of the patient. Although a variety of medication and psychologic treatments are currently available, ongoing basic and clinical research of all aspects of mild head injury are crucial to provide more efficacious treatment in the future.

Goldberg LD, Dimeff RJ (2006). Sideline management of sport-related concussions. Sports Med Arthrosc 14(4):199-205.

Concussions remain one of the most troublesome injuries sports physicians face. Studies suggest recovery takes hours to weeks, but at what point is the concussed brain no longer at increased risk for reinjury is unknown. Physicians must be alert to the symptoms of concussion and be familiar with the available tools to assess neurocognitive dysfunction. Prospectively validated signs and symptoms include amnesia, loss of consciousness, headache, dizziness, blurred vision, attention deficit, memory, postural instability, and nausea. A player with any signs or symptoms of a concussion should not be allowed to return to the current game or practice and should be monitored closely for deterioration of symptoms. Return-to-play should be individually based and proceed in a step-wise manner. The ongoing risk-benefit analysis of return-to-play must currently be based on experience, corollary data from traumatic brain injuries in animals and humans, and limited prospective data with sports-related concussions.

Guskiewicz KM (2011). Balance assessment in the management of sport-related concussion. Clin Sports Med, 30(1):89-102, ix.

Although neuropsychological testing has proven to be a valuable tool in concussion management, it is most useful when administered as part of a comprehensive assessment battery that includes grading of symptoms and clinical balance tests. A thorough sideline and clinical examination by the certified athletic trainer and team physician is considered an important first step in the management of concussion. The evaluation should be conducted in a systematic manner, whether on the field or in the clinical setting. The evaluation should include obtaining a history for specific details about the injury (eg, mechanism, symptomatology, concussion history), followed by assessing neurocognitive function and balance, which is the focus of this article. The objective measures from balance testing can provide clinicians with an additional piece of the concussion puzzle, remove some of the guesswork in uncovering less obvious symptoms, and assist in determining readiness to return safely to participation.

Guskiewicz KM (2001). Postural stability assessment following concussion: one piece of the puzzle. Clin J Sport Med, 11(3):182-9.

Clinicians regularly assess concussion according to the symptoms that an athlete manifests at the time of injury, as well as during subsequent evaluations. The subjectivity involved with symptom assessment, however, often leaves the clinician without a clear picture of the athlete's true mental status. Neuropsychologic testing has become very popular in the sports medicine community for assessing the cognitive domain of neurologic functioning, and postural stability testing is gaining credence for assessing the motor domain. The objective of this review was to determine the efficacy of postural stability testing as an adjunct to concussion assessment of athletes. Multiple studies, using both sophisticated force plate technology, as well as those using less sophisticated clinical balance tests, have identified postural stability deficits lasting several days following sport-related concussion. It appears that postural stability testing provides a useful tool for objectively assessing the motor domain of neurologic functioning, and should be considered a reliable and valid adjunct to the assessment of athletes suffering from concussion. Although symptom severity,

neurocognitive function, and postural stability are often affected initially following concussion, they are not necessarily related or even affected to the same degree.

Johnston KM, McCrory P, Mohtadi NG, Meeuwisse W (2001). Evidence-based review of sport-related concussion: clinical science. Clin J Sport Med, 11(3):150-9.

The clinical nature of sport-related concussion is discussed in this paper. Particularly highlighted are the difficulties with definition, injury severity grading, classification, and understanding of clinical symptoms. In addition, the well-recognized sequelae of concussion including the motor and convulsive manifestations are discussed in detail. Where possible, an evidence-based approach is adopted to assist the understanding of the literature in this complex area.

Kissick J, Johnston KM (2005). Return to play after concussion: principles and practice. Clin J Sport Med, 15(6):426-31.

OBJECTIVE: The sport medicine team is increasingly being asked to manage concussed athletes and to provide written clearance for return to play postconcussion, making it critical to have a good understanding of concussion recognition, assessment, and management. DATA SOURCES/SYNTHESIS: A handy way to think of concussion management is the four Rs: recognition, response, rehabilitation, and return. RESULTS: Athletes, coaches, parents, therapists, and physicians need a thorough understanding of concussion signs and symptoms. An athlete suspected of having sustained a concussion should be removed from the game or practice and assessed by a member of the sideline medical team. All athletes who sustain a concussion should be evaluated by a medical doctor. Rehabilitation has similarities to but also differs from the traditional orthopedic model in that the first step is rest, both physical and cognitive. Once asymptomatic at rest, a step-wise return to activity is undertaken.

CONCLUSIONS: This protocol has been adapted for various sports. It may be used for children, although it is prudent to be more conservative and to progress more slowly than in an older age group.

Kushner DS (2001). Concussion in sports: minimizing the risk for complications. Am Fam Physician, 15;64(6):1007-14.

Mild traumatic brain injury, or concussion, is a common consequence of collisions, falls and other forms of contact in sports. Concussion may be defined as an acute trauma-induced alteration of mental function lasting fewer than 24 hours, with or without preceding loss of consciousness. The physician's responsibilities in assessing an athlete with concussion include determining the need for emergency intervention and offering guidance about the athlete's ability to return to play. Concussion may be complicated by cerebral edema related to the second impact syndrome, cumulative neuropsychologic deficits, intracranial bleeding or the postconcussion syndrome. The risk of complications is increased in athletes who prematurely return to play and in those with prolonged loss of consciousness or post-traumatic amnesia. An athlete with prolonged loss of consciousness or signs and symptoms that worsen or persist after a concussion should be evaluated in the emergency department. An athlete should not be allowed to resume sports participation until all symptoms of a concussion have resolved.

Leclerc S, Lassonde M, Delaney JS, Lacroix VJ, Johnston KM (2001). Recommendations for grading of concussion in athletes. Sports Med, 31(8):629-36.

Mild sports-related concussions, in which there is no loss of consciousness, account for >75% of all sports-related brain injury. Universal agreement on concussion definition and severity grading does not exist. Grading systems represent expertise of clinicians and researchers yet scientific evidence is lacking. Most used loss of consciousness and post-traumatic amnesia as markers for grading concussion. Although in severe head injury these

parameters may have been proven important for prognosis, no study has done the same for sport-related concussion. Post-concussion symptoms are often the main features to help in the diagnosis of concussion in sport. Neuropsychological testing is meant to help physicians and health professionals to have objective indices of some of the neurocognitive symptoms. It is the challenge of physicians, therapists and coaches involved in the care of athletes to know the symptoms of concussion, recognise them when they occur and apply basic neuropsychological testing to help detect this injury. It is, therefore, recommended to be familiar with one grading system and use it consistently, even though it may not be scientifically validated. Then good clinical judgement and the ability to recognise post-concussion signs and symptoms will assure that an athlete never returns to play while symptomatic.

Lovell M (2009). The management of sports-related concussion: current status and future trends. Clin Sports Med, 28(1):95-111.

This article provides a review of current trends in the management of sports-related concussion. An evidence-based approach to concussion management is presented with a specific focus on return-to-play issues. The use of neuropsychological testing and other diagnostic tools is presented and reviewed.

McCrory P, Johnston K, Meeuwisse W, Aubry M, Cantu R, Dvorak J, Graf-Baumann T, Kelly J, Lovell M, Schamasch P (2005). Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004. Br J Sports Med, 39(4):196-204.

In November 2001, the 1st International Symposium on Concussion in Sport was held in Vienna, Austria to provide recommendations for the improvement of safety and health of athletes who suffer concussive injuries in ice hockey, football (soccer), and other sports. The 2nd International Symposium on Concussion in Sport was organised by the same group and held in Prague, Czech Republic in November 2004. It resulted in a revision and update of the Vienna consensus recommendations, which are presented here.

McKeever CK, Schatz P (2003). Current issues in the identification, assessment, and management of concussions in sports-related injuries. Appl Neuropsychol, 10(1):4-11.

The recent literature has focused on the need for appropriate identification, assessment, and management of sports-related concussion. This article addresses current issues in the prevalence and assessment of sports-related concussion. Despite a paucity of research on female athletes and youth athletes, there is evidence that female athletes are at higher risk for injury than males and that concussions may affect children and young adolescents differently than older adolescents and adults. Sideline, baseline, and postconcussion assessments have become prevalent in documenting preinjury and postinjury performance, tracking recovery rates, and assisting return-to-play decisions. New computerized assessment procedures are growing in popularity and use. Future directions in the assessment and management of sports-related concussion include increased research on prevalence rates and effects of concussions for females and youth athletes, educating parents of youth athletes as well as family physicians on the importance of baseline and postconcussion cognitive assessments, and further validation of computerized assessment measures.

Purcell L (2009). What are the most appropriate return-to-play guidelines for concussed child athletes? Br J Sports Med;43 Suppl 1:i51-5.

OBJECTIVE: To examine concussion literature for specific guidelines regarding return to play (RTP) following sport-related concussion in child athletes. To make recommendations regarding the most appropriate RTP guidelines for child athletes following sport-related concussion.

DESIGN: A literature review of concussion literature. INTERVENTION: A literature search was conducted using Medline and Embase databases from 1998 to 2008. More than 60 articles and two websites were reviewed. RESULTS: There is a paucity of research on sport-related concussion in child athletes, particularly younger children (age 5-12 years). In particular, there is no research on RTP guidelines for child athletes following sport-related concussion. Child athletes take longer to recover from concussions than adults. Concussion symptoms may resolve before cognitive function has completely recovered. Concussion assessment and management in children can be confounded by their growth and development, as well as the lack of trained medical personnel involved with youth sports. There are no child-specific assessment tools for concussion. CONCLUSIONS: RTP decisions in children should be made cautiously and should be individualised. No concussed child athlete should be allowed to RTP the same day. Physical and cognitive rest is very important to allow for the resolution of concussion symptoms. Child athletes should remain symptom free for several days before starting a medically supervised stepwise exertion protocol. Further research is needed to elucidate the effects of concussion in children and to determine the most appropriate RTP guidelines. Child-specific concussion assessment tools need to be developed to improve concussion assessment and management in children.

Putukian M (2006). Repeat mild traumatic brain injury: how to adjust return to play guidelines. Curr Sports Med Rep, 5(1):15-22.

Determining when it is safe for an athlete to return to play (RTP) after concussion is one of the most difficult decisions facing the team physician. There is significant variability in the evaluation and management of mild traumatic brain injury (mTBI). In the past decade, a tremendous amount of sport-specific research has improved our understanding of mTBI. The advent of neuro-psychologic (NP) testing batteries designed to assess concussive injury has improved the assessment of cognitive dysfunction that occurs in the absence of structural brain abnormalities. The severity of injury is determined by the nature, burden, and duration of symptoms. Athletes must be asymptomatic and have a normal neurologic and cognitive evaluation prior to RTP. Several factors aid in making the RTP decision, including age, the severity of injury, and history of prior mTBIs. Given the potential complications of mTBI, the RTP decision must be made using a thoughtful, individualized process.

Randolph C, Mills S, Barr WB, McCrea M, Guskiewicz KM, Hammeke TA, Kelly JP (2009). Concussion symptom inventory: an empirically derived scale for monitoring resolution of symptoms following sport-related concussion. Arch Clin Neuropsychol, 24(3):219-29.

Self-report post-concussion symptom scales have been a key method for monitoring recovery from sport-related concussion, to assist in medical management, and return-to-play decision-making. To date, however, item selection and scaling metrics for these instruments have been based solely upon clinical judgment, and no one scale has been identified as the "gold standard". We analyzed a large set of data from existing scales obtained from three separate case-control studies in order to derive a sensitive and efficient scale for this application by eliminating items that were found to be insensitive to concussion. Baseline data from symptom checklists including a total of 27 symptom variables were collected from a total of 16,350 high school and college athletes. Follow-up data were obtained from 641 athletes who subsequently incurred a concussion. Symptom checklists were administered at baseline (preseason), immediately post-concussion, post-game, and at 1, 3, and 5 days post-injury. Effect-size analyses resulted in the retention of only 12 of the 27 variables. Receiver-operating characteristic analyses were used to confirm that the reduction in items did not reduce sensitivity or specificity. The newly derived Concussion Symptom Inventory is presented and recommended as a research and clinical tool for monitoring recovery from sport-related concussion.

Sawchyn JM, Brulot MM, Strauss E (2000). Note on the use of the postconcussion syndrome checklist. Arch Clin Neuropsychol, 15(1):1-8.

Symptoms of the Postconcussion Syndrome (PCS) were evaluated in a university sample, using the Postconcussion Syndrome Checklist (PCSC). Three hundred twenty-six participants completed a questionnaire regarding history of head injury, cognitive or psychosocial difficulties, and demographic data. Scores on the PCSC did not vary by self-report of head injury. Females, however, endorsed more frequent, intense, and prolonged symptomatology, regardless of history or severity of head injury. Only 5% of the sample endorsed more than 6 symptoms on the PCSC, suggesting a potentially useful cutoff for abnormality. The PCSC was significantly correlated with the Beck Depression Inventory, suggesting that general level of psychological distress is a key factor in evaluating symptoms of PCS.

Whiteside JW (2006). Management of head and neck injuries by the sideline physician. Am Fam Physician, 15;74(8):1357-62.

Injuries to the head and neck are common in sports. Sideline physicians must be attentive and prepared with an organized approach to detect and manage these injuries. Because head and neck injuries often occur simultaneously, the sideline physician can combine the head and neck evaluations. When assessing a conscious athlete, the physician initially evaluates the neck for spinal cord injury and determines whether the athlete can be moved safely to the sideline for further evaluation. This decision is made using an on-field assessment of the athlete's peripheral sensation and strength, as well as neck tenderness and range of motion. If these evaluations are normal, axial loading and Spurling testing can be performed. Once the neck has been determined to be normal, the athlete can be assisted to the sideline for assessment of concussion symptoms and severity. This assessment should include evaluations of the athlete's reported symptoms, recently acquired memory, and postural stability. Injured athletes should be monitored with serial examinations, and those with severe, prolonged, or progressive findings require transport to an emergency department for further evaluation.