Summer 2009

Management of sport-related concussions by certified athletic trainers

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MANAGEMENT OF SPORT-RELATED CONCUSSIONS BY CERTIFIED ATHLETIC TRAINERS

A Thesis

Presented to

The Faculty of the Department of Kinesiology

San José State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

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August 2009

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CERTIFIED ATHLETIC TRAINERS' MANAGEMENT OF SPORT-RELATED CONCUSSIONS

by

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ABSTRACT

MANAGEMENT OF SPORT-RELATED CONCUSSION BY CERTIFIED ATHLETIC TRAINERS

by Mark J. Tiemeier, ATC

The purpose of this research was to determine the current management practices of certified athletic trainers (ATC) concerning signs and symptoms, evaluation, and return to play following sport-related concussions relative to the NATA position statement concerning sport-related concussions. The secondary purpose was to determine ATC's awareness of the NATA position statement concerning sport-related concussions. A survey was adapted from Notebaert and Guskiewicz (2005) and administered through www.surveymonkey.com®. A random sample of 1,000 ATC's were e-mailed the survey with a 39.2% response rate. ATC's averaged 11 years 10 months of certification and 6 years, 4 months in their current position, and 58% reported managing 21+ concussions in their career. When evaluating concussions, clinical examinations (95%) was the most common tool used, followed by symptom checklist (83%), and Standardized Assessment of Concussion (72%). The most common return-to-play tools were clinical examinations (92%), physician recommendations (90%), and return-to-play guidelines (84%). Forty-six percent of ATC's performed neuropsychological testing at both baseline and post-concussion, and 81% of ATC's report as having read the 2004 NATA position statement concerning sport-related concussions. Using a $p \leq 0.05$ confidence level revealed no statistical significance between any of the demographics and questions asked.

ACKNOWLEDGEMENTS

Many thanks are needed for those who have helped me through this entire process. To Dr. Kahanov who devoted time to further my education both in and out of the classroom, and her patience and support to help me accomplish my goals. To Dr. Wughalter and Jeff Roberts who have kept me motivated throughout my time at San Jose State University. I could not have done this without their help and knowledge. To my family, especially my parents, who have supported, encouraged, and motivated me through all of the years. Many thanks to my extended family at San Francisco State University who have made "work" enjoyable and an experience I will never forget.

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Chapter 1

INTRODUCTION

Concussions are the most common form of head injuries among athletes (Moser, 2007) with consequent high morbidity rates. Sport-related concussions may lead to changes in vascular regulation, and other neurometabolic processes that lead to chronic or life-threatening consequences such as second impact syndrome (Fazio, Lovell, Pardini & Collins, 2007). The National Center for Catastrophic Sports Injury Research identified 35 probable cases of second impact syndrome between 1980 and 1993 (Fisher & Vaca, 2004), and at least 17 deaths related to second impact syndrome were reported in the literature between 1992 and 1997 (Iverson, Gaetz, Lovell & Collins, 2004). In addition, an average of eight football-related deaths per year occur due to traumatic brain injury, accounting for two-thirds of all football-related deaths (Fisher & Vaca, 2004). As a consequence of morbidity rates among athletes with head injuries, the National Athletic Trainers' Association released a position statement in 2004 concerning sports related concussions that sports medicine professionals (i.e., athletic trainers) are recommended to use for evaluation, diagnosis and treatment/referral considerations.

Certified athletic trainers are allied health care professionals who collaborate with physicians to optimize activity and participation of patients and clients. Athletic training encompasses the prevention, diagnosis, and intervention of emergency, acute, and chronic medical conditions involving impairment, functional limitations, and disabilities (NATA, 2008). Certified athletic trainers are often the first medical personnel to evaluate an athlete's injury (Notebaert & Guskiewicz, 2005) and must possess the correct

concussion evaluation skills to determine if a traumatic brain injury is present and whether or not further medical evaluation is required.

Researchers have not agreed on the standard definition or nature of concussion, but agreement exists regarding several features of clinical, pathologic, and biomechanical injury associated with head injuries (Guskiewicz, Bruce, Cantu, Ferrara, Kelly, & McCrea, 2004). When a concussion is sustained, a destructive neurometabolic cascade of events occurs in the brain. At first, excitatory neurotransmitters are released which result in cellular membrane disruption and ionic imbalances. Increasing amounts of adenosine triphosphate are required in an attempt to correct the ionic imbalances and an increase in glucose metabolism is observed within the first 24 hours after concussion. This increased glucose metabolism, combined with an initial decrease in cerebral blood flow, results in a mismatch between the energy required and that available to brain structures. The increase in glucose metabolism is followed by a period of reduced glucose uptake and metabolism which may last for as long as one month. Exercise also modulates glucose uptake in the brain and increases cortisol in a dose dependent manner, both of which could worsen the neuronal energy mismatch after concussion (Majerske, Mihalik, Ren, Collins, Reddy, Lovell & Wagner, 2008). These clinical, biological and pathologic occurrences must be understood by sports medicine professionals in order to provide appropriate evaluation, treatment and return to activity determination.

Many sport-related concussions are the result of a combined coup-contrecoup mechanism, involving damage to the brain on both the side of initial impact and the opposite side of the brain due to brain lag (Guskiewicz et al., 2004). This makes athletes

susceptible to more traumatic brain injury. The purposes of this study were: to determine the current management practices of certified athletic trainers concerning signs and symptoms of sport-related concussions, evaluation of sport-related concussions and return to play following sport-related concussions relative to the NATA Position Statement concerning sport-related concussions; and to determine certified athletic trainers' awareness of the NATA Position Statement concerning sport-related concussions.

This thesis is presented in three chapters, with the intent to construct and submit an article for submission to the *Journal of Athletic Training*. Following the Chapter 1 introduction is Chapter 2, the article in *Journal of Athletic Training* format (see Appendix A). Chapter 3 contains the extended support material, including the introduction chapter of the proposal, the literature review for the proposal, and the methods section.

Chapter 2 is the journal article detailing the study and was written according to *Journal of Athletic Training* submission guidelines (see Appendix A). The study was descriptive in nature using a web-based survey collection device, surveymonkey.com®. The study intended to determine the current management practices of certified athletic trainers concerning signs and symptoms of sport-related concussions, and evaluation of sport-related concussions and return to play following sport-related concussions relative to the NATA Position Statement concerning sport-related concussions. Results of the study indicated no significance differences between demographic variables and the questions asked, yet the majority of athletic trainers do not adhere to the NATA recommendations (NATA, 2004).

Chapter 3 is the original thesis proposal and contains the original three chapters from the proposal including the introduction, literature review and methods. The original chapters include, Chapter 1: the introduction and evaluates the need for the current research and gives a basis for the research; and Chapter 2: the literature review, which was the basis for the research and reflective point for the discussion section. Understanding the background on this topic helps provide a foundation. Previous research by Notebaert and Guskiewicz (2005) were used to establish a background to the topic. Chapter 3 from the original thesis proposal, the Methods section, discusses the protocols used within the current study. A breakdown of the participants, how the study was conducted, and how the data will be analyzed are discussed within this chapter.

Further research is needed to determine why athletic trainers do not follow the guidelines set forth by the NATA. If these reasons can be determined, programs can be implemented to target reasons and increase compliance to the NATA Position Statement. Future research should continue to assess trends in athletic trainer's management of sport-related concussions.

Chapter 2

JOURNAL ARTICLE

Certified Athletic Trainers' Management of Sport-Related Concussions

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Mark J. Tiemeier, ATC provided conception and design, and collection, analysis, and interpretation of data. Leamor Kahanov, Ed.D., ATC provided conception and design; and interpretation of data. Jeff Roberts, MS, ATC, PES, CES and Emily Wughalter, Ed.D., provided drafting, critical decisions and final approval.
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Objective: To determine the current management practices of certified athletic trainers concerning signs and symptoms of sport-related concussions, evaluation of sport-related concussions and return to play following sport-related concussions relative to the NATA Position Statement concerning sport-related concussions, as well as measurement of awareness of certified athletic trainers' of the NATA Position Statement concerning sport-related concussions.
Design and Setting: A survey was adapted from Notebaert and Guskiewicz (2005) to assess management practices of sport-related concussions. The survey was delivered through e-mail via surveymonkey.com®.
Subjects: One-thousand regular certified athletic trainers who are currently members of the National Athletic Trainers Association (NATA) working in the high school, collegiate and professional settings were surveyed.
Measurements: Descriptive statistics including means, medians, frequencies and modes were used to analyze certified athletic trainers' answers to the questions and demographics. A chi square test and cross tabulations were used to determine if significant associations existed between demographics and responses to questions.
Results: Certified athletics trainers averaged 11 years 10 months of certification, 6 years 4 months in their current position and 58% reported managing 21+ concussions in their career. When evaluating concussions, clinical examinations (95%) was the most common tool used, followed by symptom checklist (83%) and the SAC (72%). The most common return to play tools were clinical examinations (92%), physician recommendations (90%), and return to play guidelines (84%). 46% of ATCs performed neuropsychological testing at both baseline and post concussion. 81% of ATCs report as having read the 2004 NATA Position Statement concerning sport-related concussions.
Conclusions: Our findings suggest that few certified athletic trainers currently follow the guidelines proposed by the National Athletic Trainers' Association. Clinicians must continue to implement a combination of methods and tools, along with physician recommendations in order to act in accordance with the position statement.
Key Words: Head Injury, Assessment, Treatment

The Centers for Disease Control and Prevention estimates 300,000 sport-related concussions occur annually in the United States.[1] Sport-related concussions may lead to changes in vascular regulation, and other neurometabolic processes that lead to chronic or life-threatening consequences

such as second impact syndrome.[2,3] The National Center for Catastrophic Sports Injury Research identified 35 probable cases of second impact syndrome between 1980 and 1993,[4] and at least 17 deaths related to second impact syndrome were reported in the literature between 1992 and 1997.[5] In addition, an average of eight football-related deaths per year occur due to traumatic brain injury, accounting for two-thirds of all football-related deaths.[4] Certified athletic trainers (ATC), who are often the first responder, as well as health care manager, must possess the knowledge to correctly evaluate and manage concussions to minimize morbidity.

A standard definition or nature of sport-related concussion remains elusive, but agreement exists regarding several features of clinical, pathological, and biomechanical injury associated with head injuries.[6] Concussions may be caused by a direct blow to the head or a blow elsewhere on the body. An impulsive force transmitted to the head may cause an immediate and short lived impairment of neurological function. Concussions cause a gradient of clinical symptoms that may or may not involve loss of consciousness.

Certified athletic trainers working in the high school, collegiate and professional settings are often the first medical personnel to evaluate an athlete's concussion.[7] The ATC must monitor an athlete's signs and symptoms and refer the athlete to a physician if necessary. Therefore, early recognition of a sport-related concussion is vitally important to determine if an athlete should be referred to a physician for further evaluation and establishment of return to play criteria. The basis for a certified athletic trainer's knowledge and referral criteria are held to the standards of the National Athletic Trainers' Association (NATA) for concussion evaluation and management which was created as a result of the 2nd International Conference on Concussion in Sport in Prague in 2004.[6]

The purposes of this study were to: determine the current management practices of ATCs concerning signs and symptoms, evaluation, and return to play following sport-related concussions relative to the NATA Position Statement concerning sport-related concussions; and to determine ATCs awareness of the NATA Position Statement concerning sport-related concussions. The following research questions were asked: What clinical tools are ATCs using for evaluation and return to play from concussion?; How do ATCs manage concussions?; Are ATCs following the NATA Position Statement?; Do ATCs perform baseline neuropsychological testing?; How do ATCs determine concussion severity?

METHODS

Subjects

One thousand ATCs working in the high school, college and professional settings were surveyed regarding how they evaluate and manage the majority of concussions. ATCs were e-mailed a request to take the web survey through surveymonkey.com®. An Institutional Review Board awarded human subjects approval prior to data collection. Consent was indicated on the welcome page and implied by completion of the web survey. The survey remained open for three weeks following the initial e-mail. After three weeks, a follow-up e-

mail was mailed and, after one additional week, the survey was closed for data analysis.

Instrument

A 23 item survey was adapted from Notebaert et al.[7] Eight questions from this survey were used in the design of the current study. The intent of the survey was to evaluate current concussion management skills of ATCs. The first nine questions gathered demographic data including gender, employment setting, current position, highest degree obtained, completion of an NATA post-professional Master's Degree program, possessing a state license, and being an Approved Clinical Instructor. Questions 10 through 22 evaluate the subject's current evaluation and return to play guidelines for an athlete suffering from a concussion including the clinical tools used to evaluate a concussion, concussion grading scale used if applicable, and clinical tools used to return an athlete to play. Subjects were also asked if they evaluate headgear, administer neuropsychological testing, how they grade concussions, whether they give athletes aspirin while symptomatic, the regularity of checking vital signs, usefulness of a CT scan or MRI, and how long an athlete can be symptomatic and return to play on the same day of injury. Question 23 assessed if the ATC has read the 2004 NATA Position Statement.

The original survey was examined by four certified athletic trainers and one sports medicine physician for content validity. Grammatical changes were made based on the reviews. The athletic trainers' average 13 years 6 months of experience and the sports medicine physician has 4 years 6 months of experience.

Data analysis was performed as in Notebaert et al.'s[7] study so that comparisons might be made. Descriptive statistics were calculated on the data, followed by chi-square tests of association and cross tabulations using SPSS (version 17.0; SPSS Inc, Chicago, IL). Alpha level was set a priori at 0.05 for all tests.

RESULTS

A total of 392 ATCs responded to the 1000 e-mails sent out, for a response rate of 39.2%. Surveyed ATCs averaged 11 years 10 months (SD = 8.93) of certification and averaged 6 years 4 months (SD = 7.56) in their current position. More than 50% (n = 213,

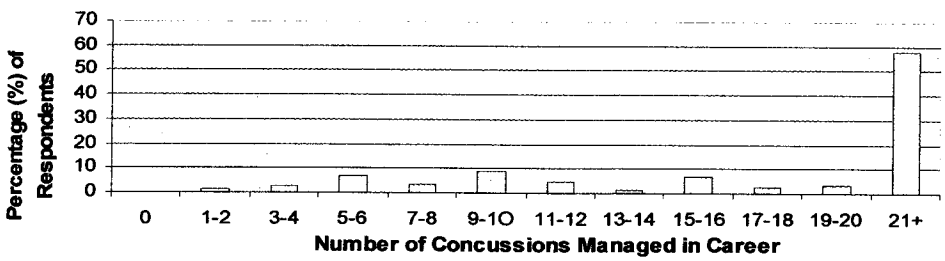

Figure 1. Frequency of concussions managed in ATCs career

55.76%) of subjects were males. More than 90% (n = 308, 93.90%) reported licensing if their state had athletic trainer licensure available. More than 70% (n = 281, 73.95%) of those surveyed had earned a master's or doctoral degree. Of these responses, approximately one-third of subjects (n = 118, 33.05%) attended an NATA post-professional Master's Degree program.

The most common responses for primary employment setting were college/university (n = 190, 50.00%) and high school (n = 152, 40.00%). The majority of respondents were head athletic trainers (n = 217, 59.62%), followed by assistant athletic trainers (n = 117, 32.14%). More than 50% (n = 202, 53.30%) reported being an Approved Clinical Instructor. The majority of ATCs (n = 208, 57.62%) report evaluating 21+ concussions in their career (Figure 1).

When evaluating concussions, 94.74% (n = 342) of subjects report using clinical examinations; 82.55% (n = 298) report using a symptom checklist; 72.30% (n = 261) report using the Standardized Assessment of Concussion; 52.08% (n = 188) report using neuropsychological testing; and 49.86% (n = 180) report using a concussion grading scale (Table 1).

Of the concussion grading scales, 35.31% (n = 101) report using Cantu Grading System for Concussion; 19.93% (n = 57) report using the American Academy of Neurology Concussion Grading; 13.64% (n = 39) report using the Colorado Medical Society Grading System for Concussion; and 7.69% (n = 22) report using a combination of guidelines (Table 2). Only 3.15% (n = 9) report using the NATA Position Statement guidelines (Table 2). Sixty-four percent (n = 230) of subjects grade concussions as grades 1 – 3 and 13.65% (n = 49) of subjects grade concussions as either simple or complex (Table 4). Sixty-three percent (n = 216) of subjects grade concussions at the time of injury and 36.84% (n = 126) grade concussions after the symptoms have resolved (Table 4).

Fifty-nine percent (n = 213) of subjects believe vital signs and level of consciousness should be checked every 5 minutes following a concussion (Table 4). Forty-six percent (n = 164) of subjects believe an athlete should never return to play on the same day of concussion whereas 21.29% (n = 76) believe an athlete can return if asymptomatic at rest and exertion for 20 minutes (Table 4). Fifty-four percent (n = 192) do not believe a CT scan or MRI is useful in determining the severity of concussion (Table 4). Seventy-eight percent (n = 239) evaluate headgear following a concussion whereas 22.40% (n = 69) do not (Table 4). Ninety-three percent (n = 329) of subjects do not believe it is appropriate to give an athlete aspirin while they are symptomatic whereas 7.32% (n = 26)

Table 1. Methods used to evaluate and diagnose concussion.

Methods used to evaluate concussion	Frequency N=361	Percent 92.09%	Valid Percent
Clinical Examination	**n = 342**	**87.24%**	**94.74%**
Grading Scale	n = 180	45.92%	49.86%
Neuropsychological tests (paper)	n = 45	11.48%	12.47%
Symptom Checklist	n = 298	76.02%	82.55%
Neuropsychological tests (computer)	n = 143	36.48%	39.61%
BESS	n = 120	30.61%	33.24%
SAC	n = 261	66.58%	72.30%
Other	n = 13	3.32%	3.60%

Table 2. Frequency of concussion grading scales

Grading Scale used	Frequency n = 286	Percent 72.96%	Valid Percent
Cantu Grading Scale	**n=101**	**25.77%**	**35.31%**
Colorado Medical Society	n = 39	9.95%	13.64%
American Academy of Neurology	n = 57	14.54%	19.93%
None of the Above	n = 49	12.50%	17.13%
NATA Position Statement	n = 9	2.30%	3.15%
Combination of Guidelines	n = 22	5.61%	7.69%
SCAT	n = 2	0.51%	0.70%
Institutional Established System	n = 1	0.26%	0.35%
Brain Injury Association of America	n = 1	0.26%	0.35%
Impact	n = 1	0.26%	0.35%
Texas State Guidelines	n = 1	0.26%	0.35%
Glasgow Concussion Scale	n = 1	0.26%	0.35%
UNC Guskiewicz Scale	n = 1	0.26%	0.35%
University Interscholastic League	n = 1	0.26%	0.35%

believe it is appropriate (Table 4).

When making return to play decisions, 91.97% (n = 332) utilized a clinical examination, 89.47% (n = 323) relied on physician recommendations, 84.21% (n = 304) followed return to play guidelines, 78.12% (n = 282) used symptom checklists, 48.48% (n = 175) used player self-report, and 45.43% (n = 164) used neuropsychological testing (Figure 2). Forty-six percent (n = 166) utilized neuropsychological testing at baseline and post-concussion while 9.70% (n = 35) utilized neuropsychological testing post-concussion only (Table 3). Eighty-one percent (n = 291) of subjects report as having read the 2004 NATA Position Statement concerning sports-related concussions (Table 4).

Chi-square tests of association were performed to assess significance between gender, the number of years certified, current position held, the number of years in current position, highest degree obtained, attendance of an NATA post-professional Master's Degree program, possessing a state license, being an Approved Clinical Instructor and number of concussions managed, methods utilized to assess, diagnose, and treat concussions, evaluating headgear, administering neuropsychological tests, giving athletes oral and written instructions for home care, grading concussions as 1 through 3 or simple and complex, and if the ATC has read the 2004 NATA Position Statement concerning sports-related concussions. No significant relationships were found between any of the demographics and concussion assessment and treatment questions. No significant relationship was found between the grading scale used and if the subject had read the NATA Position Statement.

DISCUSSION

The purposes of this study were to determine the current management practices of certified athletic trainers concerning signs and symptoms of sport-related concussions, evaluation of sport-related concussions and return to play following sport-related concussions relative to the NATA Position Statement concerning sport-related concussions and compare these trends with a comparable study conducted four years earlier. We also wanted to examine certified athletic trainers' awareness of the NATA Position Statement concerning sport-related concussion. Our survey indicates that ATCs use more tools to evaluate concussions than they were using four years ago.

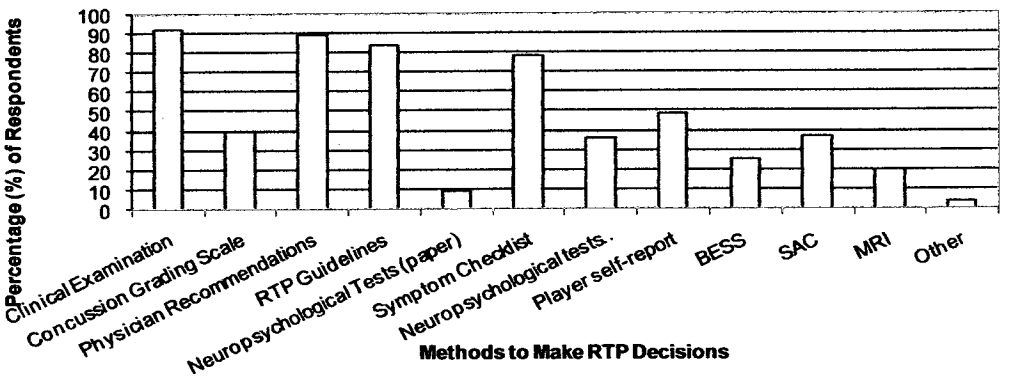

Figure 2. Frequency of methods used to make return to play decisions.

Approximately 95% of ATCs reported using clinical examinations, 83% used a symptom checklist, 72% used SAC, 52% reported using neuropsychological testing, and 33% reported using BESS (Table 3). These results help to describe the current trends in concussion management when compared with the findings of Notebaert et al.[7] that 95% used clinical examination, 85% used a symptom checklist, 48% used the SAC, 18% used neuropsychological testing and 16% used the BESS (Table 3). The improvement of tools used may be due to a different population examined, educational changes, or greater awareness of NATA guidelines.

The NATA Position Statement recommends the use of neuropsychological testing at both baseline and post-concussion for the management of concussions. Despite this, only 45% of ATCs utilize neuropsychological testing with only 46% of respondents performing neuropsychological testing at both baseline and post-concussion. Baseline testing is recommended to establish an athlete's normal pre-injury performance and to provide the most reliable benchmark against which to measure post-injury recovery.

Neuropsychological testing should not be conducted to help evaluate the severity of a concussion, but rather as a method in measuring recovery once a concussion has occurred. Despite this, 52% of ATCs reported using neuropsychological testing as a tool to evaluate a concussion and only 45% of ATCs reporting using it as a tool to assist in the return to play decision. A low percentage of subjects using neuropsychological testing may be the result of budget limitations, time

Table 3. Comparing frequency of clinical tools used for concussion evaluation between Notebaert and current data

	2005	2009
Clinical exam	95%	95%
Symptom checklist	85%	83%
SAC	48%	72%
Neuropsychological Testing	18%	52%
BESS	16%	33%

restrictions or limited computer access. The use of neuropsycholgical testing for return to play decisions may be due to current trends in providing quantifiable evidence for treatment decisions or misinterpretations of recent literature and guidelines.

The NATA Position Statement recommends that athletes playing sports with a high risk of concussion should undergo baseline cognitive and postural-stability testing. The position statement also suggests using these tests to assist in objectively determining injury severity and readiness to return to play. Despite this recommendation, only 33% of ATCs reporting using the BESS to assist in concussion evaluation and only 26% of ATCs utilized the BESS for assisting in return to play decisions. The use of objective concussion assessment tools will help ATCs more accurately identify deficits caused by injury and post-injury recovery and recovery and protect players from the potential risks associated with prematurely returning to play and sustaining a repeat concussion. The NATA Position Statement also recommends using a combination of

The NATA Position Statement suggests the ATCs should monitor vital SAC, BESS, a symptom checklist, and neuropsychological testing to more precisely evaluate recovery later after injury.

The SAC has demonstrated reliability and validity in detecting mental status changes after a concussion.[6] Although the NATA Position Statement recommends its use, only 72% of ATCs use the SAC when evaluating concussions and only 37% use it as a tool in assisting the return to play decision.

signs and level of consciousness every 5 minutes after a concussion until the athlete's condition improves. Fifty-nine percent of subjects in our study recognized this but 18% believed vital signs and level of consciousness should be checked every 10 minutes. Waiting this long to monitor signs may perpetuate a decline in the athlete's condition making optimal treatment or referral decisions difficult.

According to the NATA Position Statement, athletes who are symptomatic at rest and after exertion for at least 20 minutes should be disqualified from participation on the day of injury. Only 21% of ATCs responded to this question correctly. ATCs appear to have a more conservative approach to concussions and same-day return to play as 46% responded that an athlete should never return to participation on the day of sustaining a concussion. Athletes experiencing loss of consciousness or amnesia should be disqualified from participating on the day of injury. Even when an athlete is symptom free within 15 – 20 minutes after the concussive episode, he or she may still demonstrate delayed symptoms or depressed neurocognitive levels.[6]

None of the concussion grading scales have been universally accepted as most grading scales determine injury severity on loss of consciousness and amnesia; two symptoms that are not present in the majority of concussions. These two symptoms have also been identified as poor indicators of concussion severity. Despite this, 50% of ATCs report using a grading scale to assist in evaluating a concussion and 39% utilize one to assist in the return to play decision.

Table 4. Frequency of question responses.

	Frequency	*Percent*	*Valid Percent*
Neuropsychological testing baseline and post-concussion	***n = 361***	***92.09%***	
Yes	**n = 166**	**42.35%**	**46.00%**
No	n = 160	40.82%	44.32%
Post-Concussion only	n = 35	8.93%	9.70%
Evaluate Headgear following injury	***n = 361***	***92.09%***	
Yes	**n = 239**	**60.97%**	**66.20%**
No	n = 69	17.60%	19.11%
N/A	n = 53	13.52%	14.68%
Do you give athletes oral and written instructions for home care?	***n = 361***	***92.09%***	
Yes	**n = 256**	**65.31%**	**70.91%**
No	n = 7	1.79%	1.94%
Oral only	n = 95	24.23%	26.32%
Written Only	n = 3	0.77%	0.83%
How do you grade concussions?	***n = 359***	***91.58%***	
Grades 1-3	**n = 230**	**58.67%**	**64.07%**
Simple/Complex	n = 49	12.50%	13.65%
Neither	n = 80	20.41%	22.28%
Do you grade concussions at time of injury or after symptoms have resolved?	***n = 342***	***87.24%***	
Time of Injury	**n = 216**	**55.10%**	**63.16%**
After sx resolve	n = 126	32.14%	36.84%
Is it appropriate to give an athlete aspirin while symptomatic?	***n = 355***	***90.56%***	
Yes	n = 26	6.63%	7.32%
No	**n = 329**	**83.93%**	**92.68%**
How long can an athlete be symptomatic at rest and exertion before they are disqualified from RTP on that day?	***n = 357***	***91.07%***	
5 min	n = 46	11.73%	12.89%
10 min	n = 71	18.11%	19.89%
20 min	n = 76	19.39%	21.29%
Never	**n = 164**	**41.84%**	**45.94%**
A CT scan or MRI is useful in determining concussion severity	n = 358	91.32%	
True	n = 166	42.35%	46.37%
False	**n = 192**	**48.98%**	**53.63%**
How often should you check vital signs and LOC following a concussion?	n = 359	91.58%	
Every min	n = 14	3.57%	3.90%
Every 2 min	n = 68	17.35%	18.94%
Every 5 min	**n = 213**	**54.34%**	**59.33%**
Every 10 min	n = 64	16.33%	17.83%
Have you read the 2004 NATA Position Statement?	***n = 360***	***91.84%***	
Yes	**n = 291**	**74.23%**	**80.83%**
No	n = 69	17.60%	19.17%

Three approaches to grading sport-related concussions exist. One approach is the American Academy of Neurology Concussion Grading Scale which grades at the time of concussion based on the signs and symptoms present (Table 5). Our results indicated that 24% of ATCs utilize this grading scale and 63% of ATCs grade concussions at the time of injury. Another approach is to grade the concussion on the basis of the presence and overall duration of the symptoms. An example of this is the Cantu Evidence-Based Grading Scale (Table 5). Our results suggest that 43% of ATCs utilize this grading scale and 37% of ATCs grade concussions after the symptoms have resolved. The third approach, which is supported by the 2001 Vienna Conference on Concussion in Sport, is not to use a grading scale but focus on the athlete's recovery based on symptoms, neuropsychological tests and postural-stability tests (Table 5). Three percent of subjects report using the NATA Position Statement guidelines as a form as a concussion grading scale. However, it should be noted that this was not listed as one of the options on the survey as the NATA does not consider it a grading scale. Once the athlete is asymptomatic, a progression should take place towards return to play. The 2004 Prague Conference on Concussion in sport also recommended abandoning grading concussions as grades 1 – 3, and instead grade them as simple or complex.[8] Sixty-four percent of ATCs report grading concussions 1 – 3, and 14% grade concussions as simple or complex. A simple concussion is a concussion in which symptoms resolve without complication over 7 to 10 days, and the athlete typically resumes sport without further problems (Table 5). Simple concussions are the most common type of concussion and can be managed by a primary care physician or a certified athletic trainer under medical supervision. Management is rest until symptoms have resolved followed by a graded program of exertion before return to sport.[8]

Complex concussions occur when the athlete suffers persistent symptoms, has multiple concussions that progressively get worse, or demonstrate prolonged cognitive impairment following the injury (Table 5). Additional management considerations beyond simple return to play advice are required. These athletes should be under the care of a physician.[8]

The presence of self-reported symptoms serves as a major contraindication for return to play. Initial evidence has been provided for the structural validity of a self-report symptom scale.[6] Despite the importance of this, only 83% of ATCs reported using a symptom checklist for evaluating a concussion and 78% of ATCs reported using a symptom checklist for making a return to play decision. Some ATCs may have included self-reported symptoms as a part of their clinical examination which 95% of ATCs reporting using for evaluating concussions and 92% reported using for making a return to play decision.

The NATA Position Statement suggests giving the injured athlete and a responsible adult that will observe the athlete oral and written instructions for home care. Seventy-one percent of ATCs surveyed provided oral and written instructions for home care.

Table 5. Concussion Grading Scales

	Grade 1	Grade 2	Grade 3
Cantu Grading System	No LOC, amnesia <30 min	LOC < 5 min or amnesia > 30 min and <24 hrs	LOC > 5 min or amnesia > 24 hrs
American Academy of Neurology	Transient confusion, no LOC, S&S resolve in < 15 min	Transient confusion, no LOC, S&S last > 15 min	Any LOC
NATA Position Statement Guidelines	**Simple** Symptoms resolve without complication in 10 days, athlete resumes sport without further problems.	**Complex** Persistent symptoms, has multiple concussions that progressively get worse, or prolonged cognitive impairment following the injury	

However, 26% of ATC's only gave oral instructions. This can be a problem as a concussed athlete may have memory deficits and may not be able to recall oral instructions.

The NATA Position Statement suggests that athletes with concussion avoid medications containing aspirin or nonsteroidal anti-inflammatories, which decrease platelet function and potentially increase intracranial bleeding, mask the severity and duration of symptoms, and possibly lead to a more severe injury. Despite this, of the ATCs surveyed, 7% believed it was appropriate to give an athlete aspirin while they were symptomatic.

ATCs should play a role in enforcing the proper fitting and use of the helmet. While wearing a helmet cannot prevent a concussion, a properly fitted helmet can reduce the risk of concussions. However, after a concussion is sustained, 19% of ATCs do not check headgear.

MRI's and CT scan's are of little value in assessing cerebral concussions and making return to play decisions.[6]

These scans are unable to measure neurometabolic changes in the brain. They can only detect hematomas if present.[9] Despite this, 46% of ATCs surveyed believed an MRI or CT scan can be useful in determining concussion severity. Nineteen percent also reported using an MRI to assist in the return to play decision.

The NATA Position Statement recommends taking a team approach to make return to play decisions including the athlete, ATC and physician. Our results indicated that 90% of ATCs consult a physician when making the return to play decision which is optimal for consistent application of return to play decisions that best benefit the athlete.

Fifty-three percent of respondents reporting practicing as an Approved Clinical Instructors (ACI). ACI's are responsible for staying current on research and teaching students the most up to date information. The results suggest that most ACI's are not following the current concussion

guidelines. This would mean that current students are not learning the new guidelines in a clinical setting but are learning traditional treatments. In a push for evidence-based research and outcome measures such as the position statement, ATCs should focus on transitioning research to clinical practice.

A lack of significance in the chi-squre tests between demographics and questions was surprising. We were hoping to find that ACI's, graduating from a NATA post-professional Master's Degree program, and highest degree obtained would indicate greater compliance to the NATA guidelines. The results suggest that factors including those previously mentioned do not affect whether an ATC follows the NATA Position Statement guidelines.

Noncompliance to the NATA Position Statement guidelines may be a result of several factors. One factor may be that when a concussion is sustained, coaches and families instantly want to know the severity. Coaches and families are familiar with the grading of concussions as 1 through 3, so ATCs may use this method to explain concussions. Another factor is the coaches desire to have athletes return to play as soon possible. Therefore, some ATCs may ignore certain factors of the complete concussion management in order to return athletes to play sooner. Another reason for noncompliance may be that ATCs may be accustomed to using the grading scale system and do not want to alter practice, or that uniformed athletic trainers are perpetuating inaccurate guidelines through the educational system or mentorship.

Our study was restricted by the limitations of survey research. A potential limitation was that some of the surveys were not fully completed. We chose to include information on any question submitted, but this led to variation in the number of responses for each survey item and to the number of responses we used in general. The NATA would only allow the release of 1,000 names for research; consequently only 4.38% of all certified athletic trainers were emailed the survey which may limit generalizability. Our survey also requested a categorical number of concussions managed in one's career. The final option was 21+ concussions of which 58% of ATCs responded, which was an unexpected phenomenon unanticipated by the researchers. Future studies should request a concrete number of concussions managed to allow for differing statistical analysis.

Future research should further delineate between educators and clinicians to assess differences between ATC education and what clinicians are practicing.

CONCLUSION

Our findings suggest that while ATCs have made moderate progress in concussion assessment and management during the last four years, few certified athletic trainers currently follow the guidelines proposed by the National Athletic Trainers' Association. Clinicians must continue to implement a combination of methods and tools in order to comply with the position statement. Concussion guidelines also need to be discussed with the team physicians and reviewed with the NATA guidelines and current treatment

protocols available to the sports medicine team.

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Chapter 3

EXTENDED SUPPORT MATERIAL

Introduction

The Centers for Disease Control and Prevention estimates 300,000 sport-related concussions occur annually in the United States (Notebaert & Guskiewicz, 2005). Since sport-related concussions are the most common form of head injuries among athletes (Moser, 2007), and the possible morbidity due to concussion is high, certified athletic trainers must possess the knowledge to correctly evaluate and manage sport-related concussions. Sport-related concussions may lead to changes in vascular regulation, and other neurometabolic processes that may lead to chronic or life-threatening consequences such as second impact syndrome (Fazio, Lovell, Pardini & Collins, 2007).

The National Center for Catastrophic Sports Injury Research identified 35 probable cases of second impact syndrome between 1980 and 1993 (Fisher & Vaca, 2004). At least 17 deaths related to second impact syndrome were reported in the literature between 1992 and 1997 (Iverson, Gaetz, Lovell & Collins, 2004). In addition, an average of eight football-related deaths per year occur due to traumatic brain injury, accounting for two-thirds of all football-related deaths (Fisher & Vaca, 2004).

Researchers have not agreed on the standard definition or nature of sport-related concussion, but agreement exists regarding several features of clinical, pathologic, and biomechanical injury associated with head injuries (Guskiewicz, Bruce, Cantu, Ferrara, Kelly & McCrea, 2004). Concussions may be caused by a direct blow to the head or a blow elsewhere on the body. An impulsive force transmitted to the head may cause an immediate and short lived impairment of neurological function. Concussions cause a gradient of clinical symptoms that may or may not involve loss of consciousness.

Resolution of the clinical and cognitive symptoms typically follows a sequential course; yet, concussions typically have normal results on conventional neuroimaging studies making these images inefficient for concussion management (Guskiewicz et al., 2004). Given the lack of evidence for neuroimaging as effective concussion management, the certified athletic trainer's management and return to play knowledge becomes even more crucial to ensure the athlete does not sustain more extensive brain damage.

Certified athletic trainers working in the high school, collegiate and professional settings are often the first medical personnel to evaluate an athlete's concussion (Notebaert & Guskiewicz, 2005). The certified athletic trainer must monitor an athlete's signs and symptoms and refer the athlete to a physician if necessary. Therefore, early recognition of a sport-related concussion is vitally important to determine if an athlete should be referred to a physician for further evaluation and return to play criteria. The basis for a certified athletic trainer's knowledge and referral criteria are held to the standards of the National Athletic Trainers' Association (NATA) for concussion evaluation and management (NATA, 2004).

The National Athletic Trainers' Association is a professional organization serving certified athletic trainers. The organization has raised professional standards and established a code of ethics. The NATA mission statement is to enhance the quality of health care for the physically active through education and research in prevention, evaluation, management, and rehabilitation of injuries (NATA, 2008). Certified athletic trainers should possess current knowledge based on the most recent research concerning concussions to ensure proper health care is being given to physically active individuals.

The NATA's role is to publish position statements as a service to promote the awareness of certain issues and to supply relevant practiced information to its members.

The National Athletic Trainers' Association Position Statement concerning sport-related concussions was created based on the 2nd International Symposium on Concussion in Sport in Prague, Czech Republic in November of 2004. In November 2001, the 1st International Symposium on Concussion in Sport was held in Vienna, Austria. This meeting was organized by the International Ice Hockey Federation in partnership with the Federation Internationale de Football and the International Olympic Committee Medical Commission (McCrory, Johnston, Meeuwisse, Aubry, Cantu, Dvorak, Graf-Baumann, Kelly, Lovell, & Schamasch, 2005). These groups invited medical experts in the area of brain injury to present their research. The presented scientific research findings were composed into a consensus for the best possible management of sport-related concussions. The 2nd meeting in Prague was held to update the consensus. At this conference, the recommendation that the concussion grading scales be abandoned in favor of combined measures of recovery in order to determine injury severity and individual return to play decisions was created. Concussion severity was noted to only be determined in retrospect after all concussion symptoms are cleared, the neurological examination is normal, and cognitive function has returned to baseline (McCrory et al., 2005). The purpose of this study will be to determine the current management practices of certified athletic trainers concerning recognition of sport-related concussion signs and symptoms, evaluation of sport-related concussions and return to play from sport-related concussions relative to the NATA Position Statement. The second purpose of this study

will be to determine certified athletic trainer's awareness of the NATA Position Statement on sport-related concussion.

Problem Statement

A certified athletic trainer is an allied healthcare professional. Responsibilities of a certified athletic trainer include risk management, injury prevention, recognition, evaluation, and assessment of athletic injuries, immediate care of injury and illness, treatment, rehabilitation and reconditioning, and health care administration (NATA, 2008). Based on national standards, certified athletic trainers would be held liable for the new concussion guidelines according to the NATA Position Statement on sport-related concussion management guidelines (NATA, 2006). The complexity of concussion injuries requires clinicians to use a variety of tools to collect information, but the current tendency is to base the return to play decision on an athlete's self-reporting of symptoms and the ability to perform sport-specific tasks without a recurrence of concussion symptoms. Relying solely on athlete self-reported symptoms can be dangerous because it provides an incomplete picture of the injury (Notebaert & Guskiewicz, 2005). Subjective information provided to the athletic trainer may depict an incomplete picture resulting in an inaccurate diagnosis, treatment and early return to play leading to further harm. Using the NATA Position Statement guidelines, rather than purely subjective evaluation elucidates a complete and more accurate evaluation of the concussion and thus more appropriate treatment or quicker referral for management. A correct evaluation leads to correct management of the concussion which will reduce the likelihood of further brain injury to the athlete. The following research questions were asked: What clinical tools

are ATCs using for evaluation and return to play from concussion? How do ATCs manage concussions? Are ATCs following the NATA Position Statement? Do ATCs perform baseline neuropsychological testing? How do ATCs determine concussion severity?

Limitations

The study will be limited by the following factors:

1. Certified athletic trainers that have a current e-mail address listed with the NATA and that return the survey;
2. Training and education the certified athletic trainer possesses, i.e. Approved Clinical Instructor (ACI) for a CAATE accredited program vs non-ACI as ACI's are more likely to be current on research;
3. Biased results from certified athletic trainers that are interested in the topic;
4. Certified athletic trainers with time to respond;
5. Only 4.38% of all certified athletic trainers will be emailed the survey because the NATA only releases 1,000 e-mail addresses for a thesis study.

Delimitations

The study will be delimited to:

1. Certified athletic trainers that are members of the National Athletic Trainers' Association;
2. Certified athletic trainers that are employed in high school, collegiate or the professional setting.

Assumptions

The following are assumptions of the researcher:

1. Respondents will participate in the survey truthfully and to the best of their knowledge;
2. Respondents will read and interpret the questions in a similar fashion.

Definition of Terms

Approved Clinical Instructor. A BOC certified athletic trainer with a minimum of one year of certification and who has completed Approved Clinical Instructor training.

Anterograde Amnesia. A deficit in forming new memory after the accident (i.e. repeat the months of the year backwards).

Certified Athletic Trainer (ATC). An individual who has graduated from a CAATE-accredited athletic training program and successfully completed the Board of Certification exam.

College Setting. The place of employment for the certified athletic trainer that works at the junior college or four year college/university.

Cerebral Concussion. A mild, diffuse injury which involves an acceleration-deceleration mechanism in which a blow to the head or the head striking an object results in one or more of the following conditions: headache, nausea, vomiting, dizziness, balance problems, feeling slowed down, fatigue, trouble sleeping, drowsiness, sensitivity to light or noise, loss of consciousness, blurred vision, memory impairment or difficulty concentrating.

Employment Setting. The setting (college/university, high school, clinic, professional) where a certified athletic trainer is employed.

Educational Level. The highest degree obtained by the certified athletic trainer (ie bachelor's degree, master's degree, doctorate degree).

Entry-level Master's Degree Athletic Training Program. A master's degree program that prepares the student for the Board of Certification exam.

High School Setting. The place of employment for the certified athletic trainer working with athletes in grades 9-12.

National Athletic Trainers' Association. A professional organization serving certified athletic trainers.

Post-Certification Graduate Accredited Program: A graduate-level athletic training education program that is accredited by the National Athletic Trainers' Association.

Professional Setting. The place of employment for the certified athletic trainer working for a professional sports organization.

Retrograde Amnesia. Partial or total loss of the ability to recall events that have occurred during the period immediately preceding brain injury. i.e. the current quarter, current score, last weeks opponent.

Undergraduate Accredited Program. An athletic training entry-level bachelor's degree education program that is accredited by the Commission on Accreditation of Athletic Training Education.

Years of Experience. The number of years of work experience an athletic trainer has completed since being certified.

Importance of the Study

In 2005, certified athletic trainers employed in the professional, collegiate, high school, sports medicine clinic, corporate health, fitness, general hospital and academic department settings assessed an average of 8.2 concussions per year, up from 7.0 concussions per year reported five years earlier (Notebaert & Guskiewicz, 2005). Gessel et al. (2007) identified that rates of concussion were higher among collegiate athletes but concussions represented a higher proportion of all injuries sustained by high school athletes. With the rise of concussions, it is essential for certified athletic trainers to possess the knowledge to correctly evaluate, treat and return an athlete to play following a concussion.

Rationale for Study

I first became interested in the topic of concussion management during the first semester of my graduate assistantship. In the first pre-season soccer game, one of the athletes sustained a concussion. At this time, all of my athletic training skills were based on my undergraduate education. When discussing the management of the athlete's concussion with the head athletic trainer, I realized my knowledge was outdated. I was not aware of the 2004 NATA Position Statement on sport-related concussion. I then began to wonder how many other certified athletic trainers were managing concussions based on outdated research.

Summary

Certified athletic trainers are often the first responder for an athlete who has sustained a sports-related concussion. However, improper evaluation and management skills can place the athlete at an increased risk of permanent brain injury. Therefore, the purpose of this study was to determine the current management practices of certified athletic trainers concerning signs and symptoms of sport-related concussions, evaluation of sport-related concussions and return to play following sport-related concussions relative to the NATA Position Statement concerning sport-related concussions, as well as to determine certified athletic trainers' awareness of the NATA Position Statement concerning sport-related concussions. The intent is to construct and submit an article for submission to the *Journal of Athletic Training.*

Review of Literature

Certified athletic trainers are held liable for NATA Position Statements regarding concussion assessment and management regardless of their actual knowledge. A research study administered by Notebaert and Guskiewicz (2005) suggests that only a small percentage of certified athletic trainers adhere to the sport-related concussion guidelines proposed by the National Athletic Trainers' Association. The proposed study may result in increased concussion education, increased awareness of the NATA Position Statements, examining the current concussion evaluation and management skills used by certified athletic trainers and examining the current knowledge of concussion evaluation and management recommendations for certified athletic trainers. The current chapter will be divided into eighteen sections: Concussion Injury Statistics, Certified Athletic Trainer Education, Concussion Competency, Certified Athletic Trainers Duties, Concussions, Concussion Predisposition, Subdural and Epidural Hematomas, Post-concussion Syndrome, Second Impact Syndrome, Psychiatric Disorders, Concussion Evaluation, Previous Concussion Grading Scales, Return to Play, 2004 NATA Position Statement, Concussions and Certified Athletic Trainers, Young Athletes and Concussions, E-mail Surveys and Summary.

Concussion Injury Statistics

The Centers for Disease Control and Prevention estimates 300,000 sport-related concussions occur annually in the United States (Notebaert & Guskiewicz, 2005). Once a player has incurred an initial cerebral concussion, his or her chances of incurring a second one are 3 to 6 times greater than for an athlete who has never sustained a

concussion (Cantu, 2001). Currently, more than 1,250,000 student athletes participate in athletics at the high school level, and approximately four percent of high school and collegiate football players sustain concussions during each season (Majerske, Mihalik, Ren, Collins, Reddy, Lovell & Wagner, 2008). At the high school level, approximately 62,000 football concussions occur each year, whereas 34% of collegiate football players have been diagnosed with one concussion and 20% have been diagnosed with multiple concussions (McClincy, Lovell, Pardini, Collins & Spore, 2006).

Thirty percent of all high school and collegiate football players have reported sustaining concussions and returning to competition on the same day of injury; the remaining 70% average four days of rest before returning to participation (Guskiewicz et al., 2004). These practices place the athlete at a much higher risk of further brain injury such as second impact syndrome. At least 17 deaths related to second impact syndrome were reported in the literature between 1992 and 1997, which may have been avoided with the establishment of and adherence to proper return to play criteria (Iverson, et al., 2004). In addition, an average of eight football-related deaths occur per year due to traumatic brain injury, accounting for two-thirds of all football-related deaths (Fisher & Vaca, 2004). Second impact syndrome can be avoided if proper concussion evaluation and management occur.

Certified Athletic Trainers' Education

Students who want to become a certified athletic trainer must complete an undergraduate or entry-level graduate education program that is accredited by the Commission on Accreditation of Athletic Training Education (CAATE). In addition to

classroom work, students are also assigned to an Approved Clinical Instructor in clinical settings to practice hands-on what is learned in the classroom (NATA, 2008).

The National Athletic Trainers' Association Education Council identified Athletic Training Educational Competencies and Clinical Proficiencies necessary for effective performance as an entry-level certified athletic trainer. These competencies provide the entry-level certified athletic trainer with the essential knowledge and skills needed to provide athletic training services to patients of differing ages and genders and work, and lifestyle circumstances and needs. As the student progresses through the entry-level athletic training education program, these competencies are evaluated by Approved Clinical Instructors for mastery (NATA, 2006). Once a bachelor's degree or entry-level graduate degree is obtained, the potential athletic trainer must pass a comprehensive, computer-based certification examination administered by the Board of Certification. After passing the test, the athletic trainer must obtain continuing education units in order to maintain certification (NATA, 2008). Continuing education units require certified athletic trainers to remain current on research findings to ensure proper health services are offered to patients.

Concussion Competency

The Commission on Accreditation of Athletic Training Education is the agency responsible for the accreditation of entry-level athletic training educational programs. The mission of CAATE is to provide comprehensive accreditation services to institutions that offer athletic training degree programs and verify that all CAATE accredited programs meet the acceptable educational standards for entry-level athletic training

education. Competencies provide the entry-level ATC with the essential knowledge and skills needed to provide athletic training services to patients of differing ages, genders, work, and lifestyle circumstances and needs. The competencies are used for curriculum development and education of the student enrolled in an accredited entry-level educational program. The competencies also serve as a guide for the development of educational programs and learning experiences leading to a student's eligibility to take the Board of Certification, Inc. examination (CAATE, 2008).

The Athletic Training Educational Competencies Manual (2006) states that the educational program must present students with the most current and up-to-date knowledge and skills. This is especially important in an allied health care profession such as athletic training where the protection of the public and continuing competence is critical to professional practice. Program personnel should strive to include content and skills that reflect evidence-based knowledge and practice in all aspects of a student's educational program, including clinical experiences. Because the knowledge within a profession is dynamic, information of current practice, as represented by appropriate position statements of various professional associations/organizations, should be incorporated into the curriculum in a timely and accurate fashion. Current practice particularly applies to Position Statements issued by the National Athletic Trainers' Association. Despite this statement, there is no enforcement to ensure current practices are being taught to students.

Certified Athletic Trainer Duties

Certified athletic trainers are allied health care professionals who collaborate with physicians to optimize activity and participation of patients and clients. Athletic training encompasses the prevention, diagnosis, and intervention of emergency, acute, and chronic medical conditions involving impairment, functional limitations, and disabilities (NATA, 2008). Certified athletic trainers are often the first medical personnel to evaluate an athlete's injury (Notebaert & Guskiewicz, 2005). This is critical in the case of sport-related concussions as certified athletic trainers must possess the correct concussion evaluation skills to determine if a traumatic brain injury is present and further medical evaluation is required.

Concussions

Researchers have not agreed on the standard definition or nature of concussion, but agreement exists regarding several features of clinical, pathologic, and biomechanical injury associated with head injuries (Guskiewicz et al., 2004). Concussions may be caused by a direct blow to the head or indirectly, such as whiplash. An impulsive force transmitted to the head may cause an immediate and short-lived impairment of neurological function. The acute clinical symptoms largely reflect a functional disturbance rather than a structural injury. Concussions cause a gradient of clinical symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course and concussions typically have normal results on conventional neuroimaging studies (Guskiewicz, et al., 2004).

When a concussion is sustained, a destructive neurometabolic cascade of events occurs in the brain. At first, excitatory neurotransmitters are released which result in cellular membrane disruption and ionic imbalances. Increasing amounts of adenosine triphosphate are required in an attempt to correct the ionic imbalances and an increase in glucose metabolism is observed within the first 24 hours after concussion. This increased glucose metabolism, combined with an initial decrease in cerebral blood flow, results in a mismatch between the energy required and that available to brain structures. The increase in glucose metabolism is followed by a period of reduced glucose uptake and metabolism which may last for as long as one month. Exercise also modulates glucose uptake in the brain and increases cortisol in a dose dependent manner, both of which could worsen the neuronal energy mismatch after concussion (Majerske, Mihalik, Ren, Collins, Reddy, Lovell & Wagner, 2008).

A forceful blow to the resting, movable head usually produces maximum brain injury beneath the point of cranial impact which is called a coup injury. A moving head hitting an unyielding object usually produces maximum brain injury opposite the side of cranial impact as the brain shifts within the cranium which is called a contrecoup injury. When the head is accelerated before impact, the brain lags toward the trailing surface, thus squeezing away the cerebrospinal fluid and creating maximal shearing forces at the site. This brain lag thickens the layer of cerebrospinal fluid under the point of impact which explains the lack of coup injury in the moving head. When the head is stationary before impact neither brain lag nor disproportionate distribution of cerebrospinal fluid occurs, accounting for the absence of contrecoup injury and the presence of coup injury

(Guskiewicz et al., 2004). Many sport-related concussions are the result of a combined coup-contrecoup mechanism, involving damage to the brain on both the side of initial impact and the opposite side of the brain due to brain lag (Guskiewicz et al.). This makes athletes susceptible to more traumatic brain injury.

Concussion Predisposition

Concussion symptoms vary from case to case and are based on the force of the blow, the degree of metabolic dysfunction, the tissue damage, the duration of time needed to recover, the number of previous concussions, and the time between injuries (Guskiewicz et al., 2004). Increases in lactate production after brain injury may lead to secondary ischemic injury, which may predispose the brain to repeat injuries (Covassin, Stearne & Elbin, 2008). Animal studies have indicated decreased cerebral blood flow up to 10 days after a concussion, and this decreased blood flow may be a mechanism that predisposes athletes with a history of concussion to a longer recovery or to further injury (Covassin et al., 2008). Certified athletic trainers who are unaware of this predisposition may inadvertently return athletes to play subjecting them to further injury.

Long-term disability or problems are rarely associated with a single concussion. The long-term problems are believed to be associated with multiple concussions (Iverson et al., 2004). High school and collegiate football players who sustain a concussion are nearly three times more likely to sustain a second concussion in the same season than those players who have not sustained a previous injury (Guskiewicz, Weaver, Padua & Garrett, 2000). Guskiewicz et al. (2000) also identified the total number of reported signs and symptoms associated with recurrent injury to be 5.5, compared with only 3.5 for non-

recurrent injury. Guskiewicz at al. (2003) found that 1 in 15 players with a concussion had additional concussions in the same playing season and that these re-injuries typically take place in a short window of time following the first concussion. This may be accounted for by increased intracellular calcium, mitochondrial dysfunction, impaired oxidative metabolism, decreased glycolysis, axonal disconnection, neurotransmitter disturbances or delayed cell death. Certified athletic trainers that understand the physiology of a concussion understand the importance of the establishment of and adherence to appropriate return to play criteria.

Subdural and Epidural Hematomas

Subdural and epidural hematomas are examples of focal, vascular emergencies. Signs and symptoms can include loss of consciousness, cranial nerve deficits, mental status deterioration, and concussion symptoms that worsen. A red flag that an athlete has a hematoma is when the aforementioned signs and symptoms appear after an initial lucid period in which the athlete seemed normal (Guskiewicz, 2004). Subdural hematoma results from tearing the surface vessels of the brain, with hemorrhage in the space between the brain and the dura. Bleeding usually results from veins which have a low pressure. Therefore, signs and symptoms may not show until 24 hours to two weeks following the initial injury (Sise, 2001).

Epidural hematomas present with hemorrhage between the skull and the dura. The bleeding is usually rapid as the bleeding is from arteries which are under high pressure. Epidural hematomas present with a lucid interval during which the athlete has a normal examination. As the epidural hematoma expands, intracranial pressure rises and

brain tissue is damaged resulting in a deteriorating level of consciousness. This can be anywhere from six to eight hours after the initial injury. If the diagnosis is delayed or missed, severe brain injury or death may result (Sise, 2001).

Post-concussion Syndrome

Athletes suffering from post-concussion syndrome may experience mental slowness in completing assignments, difficulty understanding verbal communication, greater distractibility and poor concentration, ineffective multitasking, and severe fatigue. It is not uncommon for students with no history of academic or behavioral difficulties to present with a gradual decline in grades on tests, incomplete homework assignments, low frustration tolerance, and weak self-confidence because of an undiagnosed post-concussion syndrome. Post-concussion syndrome has been noted to occur in as many as one-half of all cases of concussion (Fisher & Vaca, 2004). Leddy et al. (2007) proposed that post-concussion syndrome occurs because the disturbances in brain physiology and whole body physiology as a result of concussive injury prevent a return to homeostasis. Over time, if the condition is untreated and if the student, family, and school have not been educated about concussion, behavioral difficulties, family conflict, and depression may ensue (Moser, 2007).

When signs and symptoms persist for beyond three weeks, it is suggested that athletes have progressed from transient injury to semi-permanent brain injury (Leddy et al., 2007). A differential diagnosis for post-concussion syndrome should include depression, somatization, and chronic pain. Somatization is the process by which psychological distress is expressed as physical symptoms. A significant risk factor for

post-concussion syndrome is three or more prior concussions. Leddy et al. (2007) proposed that whole body aerobic exercise rehabilitation of progressively increasing intensity that is performed at submaximal intensities so as not to exacerbate symptoms will improve central regulatory and autoregulatory function and may help to resolve some post-concussion symptoms, especially in athletes. The diagnosis of post-concussion syndrome is important in concussion management to reduce the risk of cumulative head injury and potential second impact syndrome.

Second Impact Syndrome

Second impact syndrome is rare; however, it is often fatal. Second impact syndrome can occur from an athlete returning to competition before he or she has fully recovered from a concussion and when a second blow is sustained that may be less forceful than the first. However, there is an immediate, devastating brain response, which then typically results in brainstem failure within minutes, and fatality or severe neurological impairment occurs before the athlete can receive appropriate medical assistance (Moser, 2007). The athlete's brain has cerebral edema, and the second impact precipitates a loss in the ability of the brain to autoregulate intracranial and cerebral perfusion pressure. This is followed by a massive cerebral hyperemia and cerebral edema followed by fatal herniation (Fisher & Vaca, 2004).

The National Center for Catastrophic Sports Injury Research identified 35 probable cases of second impact syndrome between 1980 and 1993 (Fisher & Vaca, 2004). At least 17 deaths related to second impact syndrome were reported in the

literature between 1992 and 1997 (Iverson, Gaetz, Lovell & Collins, 2004). Second impact syndrome can be avoided if proper concussion evaluation and management occur.

Psychiatric Disorders

Although rare, psychiatric disorders can result from traumatic brain injury. Factors that can predispose an athlete to psychiatric disorders include previous mental health problems, a family history of mental health problems, pre-injury dependence on alcohol or drugs, and previous brain injury (Fleminger, 2008).

The frontal lobe and temporal lobes of the brain play key roles in social behavior, so contusions to these areas can cause a disturbance in social behavior. Therefore, changes to the way an athlete behaves and reacts can occur. Athletes may depict reduced social perceptiveness, reduced control and self-regulation, problems initiating and planning behavior, emotional changes, or difficulties learning from experience. Athletes who suffer head injuries are at a greater risk of aggression, as this is associated with frontal lobe damage (Fleminger, 2008).

Anxiety and depression are common after head injury. Headache, fatigue and concentration problems are all likely to be aggravated by increased anxiety. Depression may set in when an athlete has decreased motivation or increased social withdrawal and disengagement from rehabilitation. Depression can also occur when the athlete learns he or she may not be able to participate for an extended period of time. Certified athletic trainers must be aware of changes in an athlete's mental status so proper treatment can take place.

Concussion Evaluation

Results of a thorough clinical examination conducted by both the certified athletic trainer and physician are important aspects of concussion management. Concussion evaluations should include a thorough history investigating the number and severity of previous head injuries, observation, including pupil responses, palpation of the head and neck, and special tests, including special tests of memory, concentration, and coordination, and a cranial nerve assessment (Guskiewicz et al., 2004).

The NATA position statement states that the evaluation of a concussion should include records of the time of injury and current signs and symptoms. The certified athletic trainer should monitor vital signs and level of consciousness every five minutes after a concussion until the athlete's condition improves. The athlete should also be monitored in the following days to assess recovery. Signs and symptoms that should be noted include retrograde and anterograde amnesia, loss of consciousness, headache, concentration problems, dizziness, blurred vision, poor concentration, poor balance/coordination, nausea, ringing in ears, seeing stars, sensitivity to light and noise, a vacant stare, and nausea/vomiting. In addition to signs and symptoms, cognitive and postural-stability testing must be used to objectively determine severity and readiness for return to play (Guskiewicz et al., 2004). Retrograde amnesia is the inability to recall information before the injury occurred and is evaluated by asking the athlete who the current opponent is or the date. Anterograde amnesia is the inability to recall information that occurred after the injury and can be evaluated by asking the athlete to repeat the months of the year backwards. If any of these aspects of evaluation and management are

overlooked, the certified athletic trainer will not have a complete understanding of the injury severity. Overlooking any of these signs and symptoms can increase the risk of further damage to the athlete for which the certified athletic trainer would be held liable.

Concussed athletes have increased heart rates at rest and after both cognitive and physiological stress. This may be due to disturbed autonomic nervous system function after concussion as indicated by altered heart rate variability. Concussed athletes also demonstrate greater sympathetic nervous system and lower parasympathetic nervous system activity. Altered autonomic regulation is believed to be due to changes in the autonomic centers in the brain. Cerebral autoregulation and cerebral blood flow are also disturbed after concussion which may be why concussion symptoms often reappear or worsen with physical exertion or other stress, as the brain's ability to maintain constant blood flow in the face of fluctuating mean arterial blood pressure is impaired after concussion. The cerebrovascular response to arterial carbon dioxide tension, which is a fundamental physiological mechanism to maintain adequate blood flow to the brain, is diminished in severely brain injured individuals. Other systemic effects of concussion include altered hepatic and renal cytochrome P450 enzyme activity, which has implications for drug metabolism and clearance after concussion, sleep, and circadian rhythm disruption, and the release of pro-inflammatory cytokines into the circulation after concussion. Concussion is also associated with depressed mood and fatigue (Leddy, Kozlowski, Fung, Pendergast & Willer, 2007).

An athlete should be referred to a physician if he or she experiences loss of consciousness on the field; amnesia lasting longer than 15 minutes; deterioration of

neurological function; decreasing level of consciousness; decrease or irregularity in respirations; decrease or irregularity in pulse; increase in blood pressure; unequal, dilated, or unreactive pupils; cranial nerve deficits; any signs or symptoms of associated injuries, spine or skull fracture, or bleeding; mental status changes; seizure activity; vomiting; motor deficits, sensory deficits, balance deficits, or cranial nerve deficits subsequent to initial on-field assessment; post-concussion symptoms that worsen; additional post-concussion symptoms as compared with those on the field; or if the athlete is still symptomatic at the end of the game. An athlete should be referred after the day of injury if there are any of the findings in the day of injury referral category; post-concussion symptoms worsen or do not improve over time; increase in the number of post-concussion symptoms reported; or if post-concussion symptoms begin to interfere with the athlete's daily activities. Asymmetric pupils or changes in the pupillary light response are signs of brainstem herniation. The severity of changes in pupillary response caused by herniation reflects the increased intracranial pressure (Sise, 2001). The assessment and return to play from concussion should involve a variety of medical specialists (Guskiewicz et al., 2004). These changes in signs and symptoms may be indicative of a more serious head injury. Delays in seeking proper medical attention could lead to increased risks of further brain damage including death and decrease the chances for recovery.

X-rays of the cervical spine should be ordered by a physician in a concussed athlete complaining of numbness in the extremities, motor strength weakness, or altered levels of consciousness. A physician that has any suspicion of an underlying serious

brain injury should refer the athlete immediately for a computerized tomography (CT) scan of the head. CT scans are superior to MRI's for radiographically visualizing acute intracranial bleeding. A CT scan that reveals any evidence of a cerebral contusion, subdural or epidural hematoma, or intraparenchymal bleeding, warrants neurosurgical consultation (Fisher & Vaca, 2004).

An athlete should be disqualified from competition when the athlete is symptomatic for at least 20 minutes. If an athlete returns to competition because symptoms resolved within 20 minutes, they should be monitored closely and re-evaluated on the sideline after the practice or game and 24 and 48 hours postinjury. Epidural hematoma, which is arterial bleeding between the dura mater and the skull, often present with a lucid interval during which the athlete has a normal examination. As the epidural expands, intracranial pressure rises and the level of consciousness rapidly deteriorates. If the diagnosis is delayed or missed, severe brain injury or death may result (Sise, 2001). Therefore, the athlete must be closely monitored.

An athlete cannot return to play if they experienced loss of consciousness or amnesia. If assessment tools such as the Standardized Assessment of Concussion (SAC), Balance Error Scoring System (BESS), neuropsychological tests and symptom checklist are not used, a seven-day symptom-free waiting period before returning to participation is recommended. Certified athletic trainers should also be more conservative with athletes who have a prior history of concussion than those athletes who have sustained their first concussion, as athletes with multiple concussions are more vulnerable for future concussions (Guskiewicz et al., 2004).

The SAC test, BESS test, and neuropsychological tests offer objective information regarding cognitive functioning, postural stability and post-concussion signs and symptoms. Objective tests must be conducted as athletes may under report symptoms. Athletes may deny symptoms due to internal or external pressure to compete, or athletes may not want to be perceived as "weak" if they cannot participate due to post-concussion symptoms. Also, all concussions present with different symptoms, so the athlete may not associate his or her symptoms with a concussion (Fazio et al., 2007).

For all tests, baseline testing should occur before the athletic season begins. Baseline testing provides a "normal" score for the athlete which is compared to post-injury scores. Baseline testing that does not take place inhibits an understanding of the athlete's post-injury score. Post-injury scores can be compared to population normative values; however, these values are not as accurate as they are not specific to the athlete (Guskiewicz et al., 2004).

The SAC test is an objective tool for assessing the injured athlete's mental status during the acute period after a concussion. The SAC test includes measures of orientation, immediate memory, concentration, and delayed recall that sum to 30 points. The athlete's post-injury score should be compared to their baseline score conducted prior to the start of the season. A lower score indicates a more severe cognitive impairment. The SAC also assesses strength, sensation, and coordination and includes a standard neurological examination which evaluates occurrence and duration of loss of consciousness and amnesia. The SAC is most useful in the assessment of acute, cognitive dysfunction resulting from concussion, with sensitivity and specificity

comparable to extensive neuropsychological testing batteries during the initial two to three days after concussion (Guskiewicz et al., 2004).

The BESS test's the athlete's balance by utilizing three stances on both a firm and foam surface with the eyes closed for a total of six trials. The stances utilized are single leg, double leg and tandem stance. Performance is scored by adding one point for each error. Errors include lifting hands off of their iliac crests, opening their eyes, stepping, stumbling, or falling, moving their hip into more than 30° of flexion or abduction, lifting their forefoot or heel, or if the athlete remains out of the testing position for more than five seconds. This test should be performed 20 minutes after exertion to avoid the effects of fatigue (Schnirring, 2004). The BESS test can be used as a clinical measure in identifying balance impairment that could indicate a neurological deficit (Guskiewicz et al., 2004). Currently, no neuroanatomic or physiologic measurements exist that can be used to determine the severity of a concussion or when complete recovery has occurred in an individual athlete after a concussion (Guskiewicz et al., 2004).

Previous Concussion Grading Scales

Twenty documented grading systems for concussions exist; however, none are research based (Moser, 2007). The most popular grading scales for concussions are the Cantu Grading Scale, the Colorado Medical Society Grading System, and the American Academy of Neurology Practice Parameter Grading System.

A grade one concussion according to the Cantu scale is no loss of consciousness and post-traumatic amnesia lasts for less than 30 minutes (see Table 5). A grade two concussion consists of loss of consciousness less than five minutes in duration or post-

traumatic amnesia that lasts longer than 30 minutes but less than 24 hours in duration. A grade three concussion has loss of consciousness for more than five minutes or post-traumatic amnesia for more than 24 hours (Cantu, 2001).

According to the Colorado Medical Society Grading System, a grade one concussion presents with confusion without amnesia and no loss of consciousness (see Table 5). A grade two concussion has confusion with amnesia and no loss of consciousness. A grade three concussion is any concussion with loss of consciousness (Cantu, 2001).

A grade one concussion according to the American Academy of Neurology presents with transient confusion, no loss of consciousness and concussion symptoms or mental status abnormalities on examination resolve in less than 15 minutes (see Table 5). A grade two concussion presents with transient confusion, no loss of consciousness and the concussion symptoms or mental status abnormalities on examination last more than 15 minutes. A grade three concussion is any concussion with loss of consciousness (Cantu, 2001). This scale bases injury severity on loss of consciousness. A problem with this is that many concussions progress differently than expected on initial evaluation, making the return to play decisions more challenging (Guskiewicz et al., 2004).

Most concussion rating guidelines grade the severity of a concussion on loss of consciousness and amnesia. However, these symptoms are rarely observed in concussions and the guidelines ignore other signs and symptoms (Notebaert & Guskiewicz, 2005). Loss of consciousness is also not always predictive of recovery after a brain injury (Guskiewicz et al., 2004). A study conducted by McClincy et al. (2006)

found that of the 103 concussions examined, only nine athletes sustained a loss of consciousness and each case of unconsciousness lasted less than 20 seconds. Likewise, only 23 athletes suffered from anterograde amnesia while only 19 athletes presented with retrograde amnesia. Guskiewicz et al. (2000) also suggested that a concussion is rarely associated with a loss of consciousness (8.9% of injuries) or amnesia (27.7% of injuries). According to these guidelines, an athletic trainer can just ignore other signs and symptoms such as balance, pupil reaction, nausea and headache severity when determining the concussion grade. A certified athletic trainer who still uses one of these grading scales incurs an incomplete evaluation and potential harm due to inaccurate diagnosis.

Table 6: Summary of Concussion Grading Scales (Cantu, 2001)

	Grade 1	Grade 2	Grade 3
Cantu Grading System	No LOC, amnesia <30 min	LOC < 5 min or amnesia > 30 min and <24 hrs	LOC > 5 min or amnesia > 24 hrs
Colorado Medical Society	No LOC, confusion without amnesia	No LOC, confusion with amnesia	LOC
American Academy of Neurology	Transient confusion, no LOC, S&S resolve in < 15 min	Transient confusion, no LOC, S&S last > 15 min	Any LOC

Return to Play

Return to play after severe or repetitive concussive injury should be considered only if the athlete is completely symptom free and has a normal neurologic examination, normal neuropsychological and posture-stability examinations, and, if obtained, normal neuroimaging studies. Any episode involving loss of consciousness or persistent symptoms related to concussion, regardless of how mild and/or transient warrants disqualification for the remainder of that day's activities (Guskiewicz et al., 2004). Neuropsychological testing should not be considered while the athlete is symptomatic, since it does not provide information for return to play decisions, and it may contaminate the testing process by allowing for practice effects to confound the results (McCrory et al., 2005).

Guskiewicz and McCrea (2003) suggest that, on average, athletes required seven days to recover completely from a concussion. Therefore, the seven day waiting period may minimize the risk of recurrent injury. Same season repeat injuries typically take place within a short window of time, 7 – 10 days after the initial concussion, which supports the concept that there may be increased neuronal vulnerability or blood flow changes during that time (Guskiewicz et al., 2004).

Certified athletic trainers must be concerned about the potential for an athlete's condition to deteriorate. The more threatening injuries include epidural hematoma, subdural hematoma, second impact syndrome and post-concussion syndrome. Serial assessments and a physician follow up must be part of the evaluation plan for an athlete

with a concussion to help realize the potential presence of these conditions (Guskiewicz et al., 2004).

Intense exercise too soon after concussion may increase the risk of cerebral hemorrhage by increasing intracranial pressure. Exercise in the acute post-concussion period may increase brain metabolic demand at a time when the brain is energy compromised and vulnerable to secondary injury due to premature neuronal activity. Exercise too soon after concussion could also divert the brain from producing neutrophins that promote neuronal activity (Leddy et al., 2007).

Athletes with a concussion should avoid medications containing aspirin or non-steroidal anti-inflammatory (NSAIDS) medications. NSAID's decrease platelet function and potentially increase intracranial bleeding, mask the severity and duration of symptoms, and possibly lead to a more severe injury (Guskiewicz et al., 2004).

Oral and written instructions should be provided to both the athlete and the caregiver regarding at home care. The use of oral and written instructions increases the compliance to 55% for purposeful waking in the middle of the night. The athlete should be awakened during the night to check on deteriorating signs and a symptom only if s/he experienced loss of consciousness, had prolonged periods of amnesia, or was still experiencing significant symptoms at bedtime. The athlete should avoid activities that may increase symptoms and should resume normal activities of daily living, such as attending class and driving, once symptoms begin to resolve or decrease in severity. The athlete should also avoid alcohol, illicit drugs and central nervous system medications (Guskiewicz et al., 2004).

McClincy et al. (2006) found that the two most widely used return to play guideline scales were the Colorado Medical Society Guidelines and the American Academy of Neurology Guidelines (see Table 2). The Colorado and AAN guidelines allow return to play the same day of injury if symptoms resolve or do not appear within 20 minutes of injury. Both sets of guidelines permit all asymptomatic athletes sustaining a grade 2 concussion to return to play within one week of injury. The problem with these guidelines is that the scales generalize concussions for all ages, playing levels, and genders. Differences in the brain's ability to regain cognitive functioning and symptom reporting practices between individuals are not taken into account (McClincy et al., 2006). In McClincy et al.'s (2006) study, 80% of the athletes would have returned to play prematurely if the return to play decision would have been based solely on the criteria outlined in the AAN and Colorado guidelines.

Return to play after a concussion should follow the following process:

1. No activity, complete rest. Once asymptomatic, proceed to step 2;
2. Light aerobic exercise such as walking or stationary cycling, no resistance training;
3. Sport specific exercise, progressive addition of resistance training at steps 3 or 4;
4. Non-contact training drills;
5. Full contact training after medical clearance;
6. Game play

(McCrory et al., 2005).

Certified athletic trainers that follow these guidelines will not allow an athlete to return to competition prematurely, thus reducing the risk of further brain injury. Return to play can only occur once the athlete is completely symptom free and has a normal neurologic examination, normal neuropsychological and posture-stability examinations.

Table 7: Previous Guidelines for Return to Play Following Concussion (Cantu, 2001)

		First Concussion	Second Concussion	Third Concussion
Colorado Medical Society	Grade 1	RTP same day if S&S resolve within 20 min	RTP in 1 week if asymptomatic	Terminate contact sport participation
	Grade 2		RTP in 1 month if asymptomatic	Terminate contact sport participation
	Grade 3		Terminate contact sport participation	
AAN	Grade 1	RTP same day if S&S resolve within 20 min	RTP in 1 week if asymptomatic	
	Grade 2		RTP in 2 weeks if asymptomatic	
	Grade 3		RTP in 1 month if asymptomatic	

2004 NATA Position Statement

The National Athletic Trainers' Association Position Statement concerning sport-related concussions was created based on the 2nd International Symposium on Concussion in Sport in Prague, Czech Republic in November of 2004. In November 2001, the 1st International Symposium on Concussion in Sport was held in Vienna, Austria. This meeting was organized by the International Ice Hockey Federation in partnership with the Federation Internationale de Football and the International Olympic Committee Medical Commission (McCrory, Johnston, Meeuwisse, Aubry, Cantu, Dvorak, Graf-Baumann, Kelly, Lovell, & Schamasch, 2005). These groups invited medical experts in the area of brain injury to present their research. The presented scientific research findings were

composed into a consensus for the best possible management of sport-related concussions. The 2nd meeting in Prague was held to update the consensus. At this conference, international concussion experts made the recommendation that the concussion grading scales be abandoned in favor of combined measures of recovery in order to determine injury severity and individual return to play decisions. Noted was that concussion severity could only be determined in retrospect after all concussion symptoms have cleared, the neurological examination is normal, and cognitive function has returned to baseline (McCrory et al., 2005). Grading a concussion as simple versus complex is based on the length of signs and symptoms. Therefore, grading the concussion cannot occur at the time of injury because it is unknown how long recovery will last. A concussion involves the noted signs and symptoms, neurological dysfunction and cognitive dysfunction. All of these must be resolved before grading of a concussion occurs. The NATA Position Statement is the first to recommend that clinicians use neuropsychological and postural-stability tests to assist diagnosis and treatment (Schnirring, 2004).

Concussion grading also changed from grades 1 through 3, to simple and complex concussions. A simple concussion is a concussion in which symptoms resolve without complication over 7 to 10 days, and the athlete typically resumes sport without further problems. Simple concussions are the most common type of concussion and can be managed by a primary care physician or a certified athletic trainer under medical supervision. Management is rest until symptoms have resolved followed by a graded program of exertion before return to sport (McCrory et al., 2005).

Complex concussions are when the athlete suffers persistent symptoms, has multiple concussions that progressively get worse, or prolonged cognitive impairment following the injury. Additional management considerations beyond simple return to play advice are required. These athletes should be under the care of a physician (McCrory et al., 2005).

Concussions and Certified Athletic Trainers

Ferrara, McCrea, Peterson and Guskiewicz (2001) conducted a 21-item questionnaire to identify certified athletic trainers' use of various concussion evaluation tools and to determine if patterns of use vary across practice settings. The practice settings examined included professional, collegiate, high school and clinical settings. The mean number of concussions evaluated per year was 7.04. More respondents reported using the Colorado guidelines (28%) than any other specific concussion management guidelines. More than 18% of the total respondents reported not using any type of concussion grading scale or return to play guidelines. Clinical examination (33%) and a symptom checklist (15.3%) were the most common evaluation tools. Respondents also reported using various standardized assessment methods, including SAC (10.6%), BESS (5%), and neuropsychological testing (15.3%).

Notebaert and Guzkiewicz (2005) conducted a 32-question survey to investigate the current trends of certified athletic trainers in concussion assessment and management. The employment settings examined included professional, collegiate, high school, sports medicine clinic, general hospital setting, academic department, fitness center, personal trainer and corporate health. The mean number of concussions evaluated per year was

8.2. In order to assess concussion, 95% of certified athletic trainers reported using the clinical examination, 85% used symptom checklists, 48% used the Standardized Assessment of Concussion, 18% used neuropsychological testing, and 16% used the Balance Error Scoring System. The most frequently used concussion grading scale and return to play guideline belonged to the American Academy of Neurology (30%). When deciding whether to return and athlete to play, certified athletic trainers most often used clinical examination (95%), return to play guidelines (88%), symptom checklists (80%), and player self-report of symptoms (62%). The most important tools for making a return to play decision were the clinical examination (59%), symptom checklists (13%), and return to play guidelines (12%). Only about 3% of those surveyed were currently using examination that were recommended by the NATA such as using symptom checklists, neuropsychological testing, and the BESS for concussion assessment or return to play decisions. Clinicians may use other forms of postural stability testing but, even if the survey included other forms of testing, the researchers did not expect compliance with the NATA recommendations to improve. This suggests the need of increased awareness of the 2004 NATA Position Statement.

The results of Notebaert and Guskiewicz (2005) depicted a significant relationship between athletic trainers with more years of certification and increased use of neuropsychological testing. High school certified athletic trainers more frequently used symptom checklists, and college and professional certified athletic trainers more frequently used computerized neuropsychological tests compared with certified athletic trainers in different employment settings. These findings may be a result of smaller

athletic training budgets at the high school level as compared to those at the collegiate and professional level. Colleges and professional teams usually have higher budgets and therefore can afford computerized neuropsychological testing.

Majerske et al. (2008) conducted a study to examine the role of post-injury activity level in post-concussive symptoms and performance on neurocognitive tests in a population of high school student-athletes ages 13 - 18. The study identified no statistically significant relationship between symptom scores and levels of activity following injury. Researchers suggest that every test in a concussion battery is unlikely to be significant in a particular sample. This supports the idea that clinicians should use a multifaceted approach to the evaluation and management of concussions. In the study, younger athletes demonstrated worse post-concussion neurocognitive performance than older athletes showing the importance of correct evaluation and management skills at the high school setting. The study also revealed that male athletes lacked differences in neurocognitive performance and may require more cautious monitoring.

The study by Notebaert and Guskiewicz (2005) shows the lack of awareness by certified athletic trainers of the new guidelines for concussion evaluation and management. The majority of athletic trainers are using outdated materials in the management of concussions, which puts the athlete at a greater risk of further brain injury and possibly death. Athletic trainers must posses the correct knowledge to ensure complete and proper treatment is given to all athletes suffering from a concussion.

Young Athletes and Concussions

Younger athletes take longer to recover from concussions than older athletes because the brain of the young athlete is still developing. However, the effects of concussion on the developing brain is still not entirely understood (Guskiewicz et al., 2004). Younger athletes require more frequent updates of baseline measurements. Athletes under the age of 18 should also be managed more conservatively following a concussion because brain injury may lead to deficits in learning that adversely influence development (Guskiewicz et al., 2004).

McClincy et al. (2006) suggest that high school athletes may take longer to recover from a concussion than older athletes. The study utilized 104 high school and collegiate athletes that participated in football, soccer, basketball, wrestling, hockey, and field hockey. All of the athletes performed a baseline neuropsychological test. Following a sport-related concussion, the neuropsychological test and post-concussion symptom scale were administered. The high school athletes' scores of visual memory, processing speed, reaction time and symptom reporting all showed significant differences compared to their baseline levels at days 2 and 7 post-concussion and verbal memory deficits were still present 14 days after injury. Signs and symptoms lasting this long may mean more conservative return to play is necessary for high school athletes.

Iverson et al. (2004) found that young athletes who sustain multiple concussions reported significantly more symptoms and demonstrated a trend toward lower memory scores at baseline testing before future seasons. Athletes with multiple concussions also showed worse on-field severity markers including loss of consciousness, retrograde

amnesia, and aterograde amnesia associated with their next concussion as compared with athletes who were experiencing their first concussion. Athletes with multiple concussions were six times more likely to experience post-traumatic amnesia and approximately eight times more likely to experience five or more minutes of mental status disturbance. Athletes with multiple concussions also performed much lower on the memory testing at two days post-injury than athletes sustaining only one concussion.

E-mail Surveys

One strategy to determine the process a large population uses to evaluate and manage concussions is through a survey. A survey offers an easy way to collect large amounts of information. Internet surveys are less intrusive and more private than standard pencil and paper surveys, and large numbers of completed questionnaires can be completed in a very short time and at low cost (de Leeuw, 2008).

While e-mail surveys are convenient, they can have a high non-response rate. High non-response rate may be due to the following: incorrect or out of date e-mail addresses; the recipients e-mail system judging the e-mail to be spam and, therefore, not delivering it; by the recipient judging the e-mail to be spam and not opening it; or the recipient may start the survey and decide not to finish it (de Leeuw, 2008). Another potential problem with internet surveys is that only a portion of the population has access to the internet to take the survey. Computers are present in nearly all athletic training rooms, so a web-based survey will be an effective method of reaching certified athletic trainers. An e-mail will be sent to the selected athletic trainers.

Summary

A certified athletic trainer is an allied health professional. Responsibilities of a certified athletic trainer include risk management, injury prevention, recognition, evaluation, and assessment of athletic injuries, immediate care of injury and illness, treatment, rehabilitation and reconditioning, and health care administration. The complexity of concussion injuries requires clinicians to use a variety of tools to collect information, but the current tendency is to base return to play decisions on the athlete's self-reporting of symptoms and the ability to perform sport-specific tasks without a recurrence of concussion symptoms. Relying solely on this information can be dangerous because it may provide an incomplete picture of the injury (Notebaert & Guskiewicz, 2005). If trust is lacking between the athlete and athletic trainer, subjective information may show an incomplete picture.

If the certified athletic trainer follows the NATA Position Statement guidelines, a complete picture of the concussion can be revealed. A proper evaluation will inform the certified athletic trainer if further medical attention is needed. This will reduce the risk of further brain injury or possibly even death due to second impact syndrome if the athlete is permitted to re-enter the game following a concussion before symptoms have resolved. However, if improper evaluation and management continues, certified athletic trainers may be placing athletes at an increased risk of further injury.

Methods

The purpose of this study was to determine the current management practices of certified athletic trainers concerning recognition of sport-related concussion signs and symptoms, evaluation of sport-related concussions and return to play from sport-related concussions relative to the NATA Position Statement. The second purpose of this study was to determine certified athletic trainer's awareness of the NATA Position Statement on sport-related concussion. This chapter is presented in five sections: participants, instrumentation, procedures, analysis of data, and the summary. The research was compiled for a journal article for submission to the *Journal of Athletic Training* according to the journal's author notes (see Appendix A).

Participants

Participants were a volunteer sample of 1,000 certified athletic trainers who are members of the National Athletic Trainers' Association (NATA). The certified athletic trainers e-mail addresses were obtained from the NATA's public database with the approval of the District Secretary. The NATA randomly samples 1,000 certified athletic trainers and provide the researcher with the contact information. Only athletic trainers working in the high school, college, or professional settings were surveyed as they evaluate and manage the majority of concussions. One-thousand athletic trainers were e-mailed the survey (see Appendix A) with 392 (39.2%) responding.

Adequate numbers of participants are needed to represent a proper account of what the collective group feels. de Leeuw, Hox, and Dillman, (2008) recommended that 10 percent of a total population be surveyed to accurately account for the mass. As of

August 2008, there were 22,837 certified regular certified members of the National Athletic Trainers' Association. The NATA allows the release of 1,000 names for use in conducting a web-based survey thesis study. Therefore, the number of certified members that will be used only account for 4.38% of the total number of certified members eligible and, therefore, may have implications for generalization.

Instrumentation

A survey (see Appendix B) administered through www.surveymonkey.com® was used to evaluate certified athletic trainers' practices concerning current concussion guidelines and management according to the 2004 NATA Position Statement and awareness of the 2004 NATA Position Statement. The survey was composed of questions related to knowledge of the current concussion evaluation and return to play guidelines. The survey also incorporated questions concerning previous evaluation and return to play guidelines.

The survey administered by Notebaert and Guskiewicz (2005) assisted in the design of the current evaluation and management of concussions survey (8 questions). The survey section examining knowledge of the NATA Position Statement contains original questions created by the researcher. Survey questions 1 through 9 evaluate the demographics of the certified athletic trainer. Questions 10 through 18 evaluate the respondent's current evaluation and return to play guidelines for an athlete suffering from a concussion. Questions 19 through 22 are original questions created by the researcher concerning concussion evaluation, treatment and return to play decisions according to the NATA Position Statement. Question 23 asks the certified athletic trainer if they have

read the 2004 NATA Position Statement. The original survey was examined by four certified athletic trainers and one sports medicine physician for content validity. Grammatical changes were made based on the reviews. The athletic trainers' average 13 years 6 months of experience and the sports medicine physician has 4 years 6 months of experience.

Procedures

A human subject's review for the protection of human subjects was submitted to San José State University prior to beginning the study. Permission was obtained for contact information through the NATA. Participants received an e-mail requesting their time in completing the survey (see Appendix C). The e-mail contained a link to the survey which limited access to the survey. A follow-up e-mail (see Appendix D) was sent to all subjects after three weeks thanking those that have participated and encouraging others to participate in the study. One week after the follow-up e-mail was sent, the data was collected and analyzed and no other surveys were accepted for the study (de Leeuw, 2008). The results were then be obtained from www.suverymonkey.com® and transferred to SPSS for data analysis. All respondents remained anonymous and results were confidential and secure since www.surveymonkey.com® encrypts data and does not allow the researcher to view the respondent's identity.

Analysis of Data

Data analysis was performed as in Notebaert and Guskiewicz's (2005) study so that comparisons might be made. Descriptive statistics including means, medians,

frequencies and modes were used to analyze certified athletic trainers' answers to the questions and demographics. A chi-square test of association was utilized to determine if a significant association exists between demographics and responses to the questions. The demographics evaluated include: employment setting, position, years in profession, years in current position (i.e. head athletic trainer, assistant athletic trainer, graduate assistant athletic trainer), gender, level of education, whether or not the respondent has a masters degree from an NATA accredited program, state licensure, and being an Approved Clinical Instructor. A chi-square test of association was performed to assess a trend between the concussion grading scale used and whether or not the subject had read the NATA Position Statement. Cross tabulations were also performed to assess trends between all demographics and responses to the questions. Percentages of answers to each question were calculated. Frequencies, means and standard deviations were calculated for years certified and years in the subject's current position for a richer context of the data.

Summary

The purpose of this study was to determine certified athletic trainers' current evaluation and management skills regarding concussions according to the 2004 NATA Position Statement as well as their current awareness of the Position Statement. Permission was received from the Human Subject Institutional Review Board at San José State University prior to beginning the study. The survey was e-mailed to 1,000 certified athletic trainers practicing in a clinical setting. E-mail was used to contact respondents throughout the study. Data analysis included frequencies of demographic information,

and a chi-square test will be utilized to determine if a significant association exists between demographics and responses to the questions.

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APPENDIX A
AUTHOR'S GUIDE

(Revised March 2009)
The mission of the *Journal of Athletic Training* is to advance the science and clinical practice of athletic training.

SUBMISSION POLICIES

1. Submit online at http://jat.msubmit.net
2. The following forms (available at www.nata.org/jat) should be either scanned and uploaded with the manuscript or faxed to the Editorial Office (706-494-8348):
   a. Copyright form. A letter signed by each author must contain the following statements: "This manuscript 1) contains original unpublished material that has been submitted solely to the *Journal of Athletic Training*, 2) is not under simultaneous review by any other publication, and 3) will not be submitted elsewhere until a decision has been made concerning its suitability for publication by the *Journal of Athletic Training*. In consideration of the NATA's taking action in reviewing and editing my submission, I the undersigned author hereby transfer, assign, or otherwise convey all copyright ownership to the NATA, in the event that such work is published by the NATA. Further, I verify that I have contributed substantially to this manuscript as outlined in item #2b of the current Authors' Guide." By signing the letter, the authors agree to comply with all statements. Manuscripts that are not accompanied by such a letter will not be reviewed. Accepted manuscripts become the property of the NATA. Authors agree to accept any minor corrections of the manuscript made by the editors.
   b. Authorship form. The *Journal of Athletic Training* conforms to the International Committee of Medical Journal Editors' Uniform Requirements for Manuscripts Submitted to Biomedical Journals. Each author must be specifically identified in the published manuscript, in accordance with the Uniform Requirements for Manuscripts Submitted to Biomedical Journals: "Authorship credit should be based only on 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published. Conditions 1, 2, and 3 must all be met. Acquisition of funding, the collection of data, or general supervision of the research group, by themselves, do not constitute authorship." (Categories borrowed with the permission of the *Annals of Internal Medicine*.) Contributors to the manuscript who do not qualify for authorship should be thanked in the Acknowledgments section.
   c. Signed releases are required to verify permission for the *Journal of Athletic Training* to 1) reproduce materials taken from other sources, including text, figures, or tables; 2) reproduce photographs of individuals; and 3) publish a Case Report. A Case Report cannot be reviewed without a release signed by the individual being discussed in the Case Report.
3. Financial support or provision of supplies used in the study must be acknowledged. Grant or contract numbers should be included whenever possible. The complete name of the funding institution or agency should be given, along with the city and state in which it is located. If individual authors were the recipients of funds, their names should be listed parenthetically.
4. Authors must specify whether they have any commercial or proprietary interest in any device, equipment, instrument, or drug that is the subject of the article in question. Authors must also reveal if they have any financial interest (as a consultant, reviewer, or evaluator) in a drug or device described in the article.
5. For experimental investigations of human or animal subjects, state in the Methods section of the manuscript that an appropriate institutional review board approved the project. For those investigators who do not have formal ethics review committees (institutional or regional), the principles outlined in the Declaration of Helsinki should be followed (41st World Medical Assembly, Declaration of Helsinki: recommendations guiding physicians in biomedical research involving human subjects. *Bull Pan Am Health Organ*. 1990;24:606–609). For investigations of human subjects, state in the Methods section the manner in which informed consent was obtained from the subjects. (Reprinted with permission of *JAMA* 1997;278:68, copyright 1997, American Medical Association.) If informed consent was not required because the study was exempt, provide the reason for the exemption.
6. The *Journal of Athletic Training* uses a double-blind review process. Authors and institutions should not be identified in any way except on the title page.
7. Manuscripts are edited to improve the effectiveness of communication between author and readers and to aid the author in presenting a work that is compatible with the style policies found in the *AMA Manual of Style*, 10th ed. (Williams & Wilkins), 2007. Page proofs are sent to the author as PDFs for proofreading, and any changes must be returned within 48 hours. Important changes are permitted, but authors will be charged for excessive alterations. Please keep in mind that alterations are costly. Although authors will need to correct any factual or typesetter errors, text changes in excess of 5 text "blocks" will be billed to you at $5 per correction. Figure remakes (replacement figures or minor figure editing) will be billed as follows: black and white figure, $25; halftone (eg, photograph), $30; color, $75.

STYLE POLICIES

8. Each page must be formatted for 8½-by-11-inch paper, double spaced, with 1-inch margins in a font no smaller than 10 points. Include line counts on each page to facilitate the review process. Do not right justify pages.
9. Manuscripts should contain the following, organized in the listed order, with each section beginning on a separate page:
   a. Abstract and Key Words (first numbered page)
   b. Text (body of manuscript)
   c. References
   d. Legends to figures
   The title page and acknowledgments should be submitted online as supplemental materials. Tables should be submitted in a separate file, as should figures; neither should be included in the manuscript.
10. Begin numbering the pages of your manuscript with the abstract page as #1; then, consecutively number all successive pages.
11. Units of measurement shall be recorded as SI units, as specified in the *AMA Manual of Style*, except for angular displacement, which should be measured in degrees rather than radians. Examples include mass in kilograms (kg), height in centimeters (cm), velocity in meters per second ($m \cdot s^{-1}$ or m/s), angular velocity in degrees per second ($^\circ \cdot s^{-1}$), force in Newtons (N), and complex rates (mL/kg per minute).
12. Titles should be brief within descriptive limits (a 16-word maximum is recommended). If a technique is the principal reason for the report, it should be named in the title. If a disability is relevant, it should be named in the title.
13. The title page should also include the name, title, affiliation, and e-mail address of each author, and the name, address, phone number, fax number, and e-mail address of the author to whom correspondence is to be directed. No more than 4 credentials should be listed for each author. The "ATC" credential is under the copyright protection of the Board of Certification. Therefore, the proper listing of an additional state credential is "LAT, ATC" or "ATR, LAT."
14. A structured abstract of no more than 300 words must accompany all manuscripts. Type the complete title (but not the authors' names) at the top, skip 2 lines, and begin the abstract. Items that are needed differ by type of article.
    Quantitative Original Research articles: Context, Objective, Design, Setting, Patients or Other Participants, Intervention(s), Main Outcome Measure(s), Results, Conclusions, and Key Words.
    Qualitative Original Research articles: Context, Objective, Design, Setting, Patients or Other Participants, Data Collection and Analysis, Results, Conclusions, and Key Words.

Meta-Analysis and Systematic Review articles: Objective, Data Sources, Study Selection, Data Extraction, Data Synthesis, Conclusions, and Key Words.

Case Reports: Objective, Background, Differential Diagnosis, Treatment, Uniqueness, Conclusions, and Key Words.

Clinical Techniques: Objective, Background, Description, Clinical Advantages, and Key Words.

Evidence-Based Practice: Reference/Citation, Clinical Question, Data Sources, Study Selection, Data Extraction, Main Results, Conclusions, Key Words, and Commentary.

Literature Reviews: An author who wishes to submit a literature review is advised to contact the Editorial Office for instructions.

15. Begin the text of the manuscript with an introductory paragraph or two in which the purpose or hypothesis of the article is clearly stated and developed. Tell why the study needed to be done or the article written, and end with a statement of the problem (or controversy). Highlights of the most prominent works of others as related to your subject are often appropriate for the introduction, but a detailed review of the literature should be reserved for the Discussion section. In a 1- to 2-paragraph review of the literature, identify and develop the magnitude and significance of the controversy, pointing out differences among others' results, conclusions, and/or opinions. The Introduction is not the place for great detail; state the facts in *brief*, specific statements and reference them. The detail belongs in the Discussion. Also, an overview of the manuscript is part of the abstract, not the introduction. Writing should be in the active voice (for example, instead of "Subjects were selected," use "We selected subjects") and in the first person (for example, instead of "The results of this study showed," use "Our results showed").
16. The body or main part of the manuscript varies according to the type of article (examples follow); however, the body should include a Discussion section in which the importance of the material presented is discussed and related to other pertinent literature. When appropriate, a subheading on the clinical relevance of the findings is recommended. Liberal use of headings and subheadings, charts, graphs, and figures is recommended.
    a. The body of an **Original Research** or a Meta-Analysis or **Systematic Review** article consists of a Methods section, a presentation of the Results, and a Discussion of the results. The Methods section should contain sufficient detail concerning the methods, procedures, and apparatus employed so that others can reproduce the results. The Results should be summarized using descriptive and inferential statistics and a few well-planned and carefully constructed illustrations. For more information on preparing research manuscripts, authors are advised to consult the MOOSE and QUORUM statements, which are available through the *JAT* Web site.
    b. The body of a **Case Report** should include the following components: personal data (age and sex and, when relevant, race, marital status, and occupation but not name or initials), chief complaint, history of present complaint (including symptoms); results of physical examination (example: "Physical findings relevant to the rehabilitation program were ..."); medical history (surgery, laboratory results, examination, etc); diagnosis, treatment and clinical course (rehabilitation until and after return to competition); criteria for return to competition; and deviation from expectations (what makes this case unique).
    c. The body of a **Clinical Techniques** article should include both the *how* and *why* of the technique: a step-by-step explanation of how to perform the technique, supplemented by photographs or illustrations, and an explanation of why the technique should be used. The Discussion concerning the *why* of the technique should review similar techniques, point out how the new technique differs, and explain the advantages and disadvantages of the technique in comparison with other techniques.
    d. The body of an **Evidence-Based Practice** article provides a short review of current scientific literature and applies the findings to clinical athletic training practice. All articles submitted for this section should be concise reviews of published systematic reviews or meta-analyses on topics relevant to the 7 domains of athletic training (Prevention, Assessment/Evaluation, First Aid/Treatment, Rehabilitation, Organization/Administration, Counseling, and Education). Reviews of individual, large, controlled clinical trials will also be considered. The review must begin with the complete article title and reference and a statement of the clinical question the review addresses. The rest of the review consists of a summary of the article and must include the following sections: data sources and search terms used; study selection (inclusion and exclusion) criteria; the methods used to extract and review data, including a list of the primary outcome measures; results of the search strategy; and primary outcome measures and conclusions. A separate commentary section should address the application of the information to the clinical athletic training setting. Authors may use supplementary scientific literature (up to a maximum of 5 references) to support the commentary.
17. Percentages should be accompanied by the numbers used to calculate them. When reporting no difference among groups on a key outcome measure, include a power analysis to demonstrate that the study was adequate powered. The power analysis should quantify the smallest statistically significant difference that would have been detectable with the given sample size. (Additional information on power is available at http://www.stat.uiowa.edu/~rlenth/Power/ and http://www.sportsci.org/resource/stats/index.html.) Never report a single *P* value as an inequality (eg, $P > .05$) but instead report the exact value (eg, $P = .06$). If, however, the value would be reported as $P = .00$ because of the number of significant digits allowed, then it is acceptable to state $P < .001$. When reporting groups of *P* values, it is permissible to provide an inequality (eg, "groups were similar on all demographic characteristics [$P > .05$]").
18. **Communications** articles, including official Position Statements and Policy Statements from the NATA Pronouncements Committee; Technical Notes on such topics as research design and statistics; and articles on other professional issues of interest to the readership are solicited by the *Journal*. An author who has a suggestion for such a paper is advised to contact the Editorial Office for instructions.
19. The manuscript should not have a separate summary section—the abstract serves as a summary. It is appropriate, however, to tie the article together with a list of conclusions at the end of the Discussion section or in a summary paragraph.
20. References should be numbered consecutively, using superscripted arabic numerals, in the order in which they are cited in the text. No more than 30 references should be cited in Original Research manuscripts. References should be used liberally. It is unethical to present others' ideas as your own. Also, use references so that readers who desire further information on the topic can benefit from your scholarship.
21. References to articles or books, published or accepted for publication, or to papers presented at professional meetings are listed in numerical order at the end of the manuscript. Journal title abbreviations conform to *Index Medicus* style. Examples of references are illustrated below. See the *AMA Manual of Style* for other examples.

    Journals:

    1. Boling MC, Padua DA, Creighton RA. Concentric and eccentric torque of the hip musculature in individuals with and without patellofemoral pain. *J Athl Train*. 2009;44(1):7–13.
    2. McDonough EB Jr, Wojtys EM. Multiligamentous injuries of the knee and associated vascular injuries. *Am J Sports Med*. 2009;37(1):156–159.

    Books:

    1. Ritter MA, Albohm MJ. *Sports Injuries: Your Common Sense Guide*. Traverse City, MI: Cooper Publishing Group; 2008:1–12.
    2. Massey-Stokes M. Body image and eating disturbances in children and adolescents. In: Robert-McComb JR, Norman R, Zumwalt M, *The Active Female: Health Issues Throughout the Lifespan*. Totowa, NJ: Humana Press; 2008: 57–80.

    Presentation:

    Ross SE, Linens SW, Arnold BL. Balance assessments for discriminating between functional ankle instability and stable ankles. Presented at: 59th Annual Meeting & Clinical Symposia of the National Athletic Trainers' Association; June 20, 2008; St Louis, MO.

    DVD:

    Athletic Taping and Bracing [DVD]. Champaign, IL: Human Kinetics; 2005.

Journal of Athletic Training attr-44-03-18.3d 30/4/09 00:34:21 335

Software Manual:

1. *SPSS Base for Windows* [computer program]. Version 13.0. Chicago, IL: SPSS Inc; 2005.

Internet Sources:

1. Cappaert TA, Stone JA, Castellani JW, Krause BA, Smith D, Stephens BA. National Athletic Trainers' Association position statement: environmental cold injuries. http://www.nata.org/statements/position/environmentalcoldinjuries.pdf. *J Athl Train*. 2008;43(6):640–658. Published December 2008. Accessed April 14, 2009.
2. American College of Sports Medicine. Physical activity & public health guidelines. http://www.acsm.org/AM/Template.cfm?Section=General_Public&TEMPLATE=/CM/HTMLDisplay.cfm&CONTENTID=11398. Published 2007. Accessed April 14, 2009.

22. Personal communications are cited in the text as follows: "... (J.A. Smith, written communication, January 2005)." The written or oral nature of the communication is stated, and the communication does not appear in the reference list. Authors must provide written permission from each personal-communication source. A form is available on the *JAT* Web site and from the Editorial Office.
23. Table Style: 1) Title is bold; body and column headings are roman type; 2) units are set above rules in parentheses; 3) numbers are aligned in columns by decimal; 4) footnotes are indicated by superscript letters; 5) capitalize the first letter of each major word in titles; for each column or row entry, capitalize the first word only. See a current issue of *JAT* for examples.
24. Figures: Figures should use Arial (or another sans serif font), a white background, and no box. Minimum recommended resolution is 300 DPI. Multipart figures should be mounted together and use CAPITAL letter labels (A, B, C, etc). Authors wishing color reproduction should request same in a cover letter with the submitted manuscript. Authors must pay for the additional cost of color reproduction ($750/figure) before their accepted article is typeset. For more details, consult the *JAT Figure Guidelines* at www.nata.org/jat.
25. Legends to figures are numbered with arabic numerals in order of appearance in the text. Legends should be printed on separate pages at the end of the manuscript.
26. The *Journal of Athletic Training* follows the redundant publication guidelines of the Council of Science Editors, Inc (*CBE Views*. 1996; 19:76–77; also available on the *JAT* Web site). Authors in violation of redundant publication will have sanctions invoked by the Journal Committee of the National Athletic Trainers' Association, Inc.

PUBLICATION POLICIES

27. Original Research manuscripts will be categorized under the following table of contents subheadings: clinical studies, basic science, educational studies, epidemiologic studies, and observational/informational studies.
28. Only Case Reports and Clinical Techniques that define and establish the optimal standard of care or the practice of athletic training will be considered for publication in *JAT*. Case Reports and Clinical Techniques that do not profoundly affect the standard of care but that contain potentially useful information for athletic trainers will be considered for publication in the *NATA News*.
29. Media Reviews will appear in the *NATA News*.

APPENDIX B

MANAGEMENT OF SPORT-RELATED CONCUSSIONS BY CERTIFIED ATHLETIC TRAINERS SURVEY

Dear Certified Athletic Trainer,

As a certified athletic trainer, I realize how precious your time is, however, by completing this survey you can potentially help athletic trainers understand differing concussion management strategies. Your participation is voluntary and choosing not to participate in this study, or in any part of this study, will not affect your relations with San Jose State University. No risks have been anticipated as a result of your participation in this study. The results of this study may be published, but any information that could result in your identification will remain confidential.

I understand that my consent and data may be withdrawn at any time without penalty. I have been given the right to ask questions, and my questions, if any, have been answered to my satisfaction. I understand the data will be reported in group form and individual data will be kept confidential. Completion of the survey implies the consent to utilize the confidential information you provide.

If you have any questions or concerns about this study, please feel free to contact me at (513) 675-0732, or Leamor Kahanov, Graduate Athletic Training Education Program Director, at (408) 924- 3040. Complaints about the research may be presented to Dr. Shirley Reekie, Department Chair of Kinesiology at San Jose State University, 408-924-3010. Questions about a research subjects' right, or research-related injury may be presented to Pamela Stacks, Ph.D., Associate Vice President, Graduate Studies and Research, at (408) 924-2427. Thank you for your time.

Sincerely,
Mark J. Tiemeier, ATC
San Jose State University

1. Do you wish to continue?

◯ Yes

◯ No

1. What is your gender?

- ◯ Male
- ◯ Female

2. What setting are you currently practicing in?

- ◯ High School
- ◯ High School/Clinic
- ◯ College/University
- ◯ Junior College
- ◯ Professional

3. What is your current position?

- ◯ Head Athletic Trainer
- ◯ Assistant Athletic Trainer
- ◯ Graduate Assistant Athletic Trainer

Other (please specify)

4. How many years have you held your current position?

5. How many years have you been a certified athletic trainer?

6. What is your highest degree obtained?

- ◯ Bachelor's Degree
- ◯ Master's Degree
- ◯ Ph.D
- ◯ Ed.D

7. Did you attend an NATA accredited Master's Degree program?

- ◯ Yes
- ◯ No
- ◯ N/A

8. If your state has licensure for athletic training, do you possess a license?

- ◯ Yes
- ◯ No
- ◯ N/A

9. Are you an Approved Clinical Instructor?

- ◯ Yes
- ◯ No

1. How many concussions have you managed in your athletic training career?

- ◯ 0
- ◯ 1 - 2
- ◯ 3 - 4
- ◯ 5 - 6
- ◯ 7 - 8
- ◯ 9 - 10
- ◯ 11 - 12
- ◯ 13 - 14
- ◯ 15 - 16
- ◯ 17 - 18
- ◯ 19 - 20
- ◯ 21+

2. What methods would you typically utilize to assess and diagnose concussion (check all that apply)

- ☐ Clinical examination
- ☐ Standardized Assessment of Concussion
- ☐ Symptom checklist
- ☐ Neuropsychological testing (paper/pencil)
- ☐ Balance Error Scoring System
- ☐ Neuropsychological testing (computerized)
- ☐ Concussion Grading Scale
- ☐ Other (please specify)

3. If you checked concussion grading scale, which set of concussion guidelines are you currently using?

- ☐ Cantu Grading System for Concussion
- ☐ Colorado Medical Society Grading System for Concussion
- ☐ American Academy of Neurology Concussion Grading
- ☐ None of the above

Other (please specify)

4. What methods would you typically utilize to make decisions about return to play after concussion? (check all that apply)

- [ ] Clinical examination
- [ ] Concussion grading scales
- [ ] Physician recommendations
- [ ] Return to play guidelines
- [ ] Neuropsychological testing (paper/pencil)
- [ ] Symptom Checklist
- [ ] Neuropsychological testing (computerized)
- [ ] Player self-report
- [ ] Balance Error Scoring System
- [ ] SAC test
- [ ] Head CT/brain MRI

Other (please specify) _____

5. Do you evaluate helmets and headgear following a concussion to ensure proper fitting?

- ◯ Yes
- ◯ No
- ◯ N/A

6. Do you administer a neuropsychological test baseline and post-concussion (computerized OR written)?

- ◯ Yes
- ◯ No
- ◯ Post-concussion only

7. Do you give athletes oral and written instructions for home care?

- ◯ Yes
- ◯ No
- ◯ Oral only
- ◯ Written only

8. Do you grade concussion severity as 1 through 3 or simple and complex?

- ◯ Grades 1 - 3
- ◯ Simple and Complex
- ◯ Neither

9. Do you grade concussions at time of injury or after symptoms have resolved?

- ◯ Time of injury
- ◯ After symptoms have resolved

10. Is it appropriate for an athlete with a concussion to take aspirin while symptomatic?

- ◯ Yes
- ◯ No

11. How long can an athlete be symptomatic (not including LOC or amnesia) at rest and exertion before they are disqualified from return to play on the day of injury?

- ◯ 5 minutes
- ◯ 10 minutes
- ◯ 20 minutes
- ◯ An athlete should never return to play on the same day after a concussion

12. A CT Scan or MRI is useful in determining the severity of concussion

- ◯ True
- ◯ False

13. How often should you check vital signs and level of consciousness following a concussion?

- ◯ Every minute
- ◯ Every 2 minutes
- ◯ Every 5 minutes
- ◯ Every 10 minutes

14. Have you read the 2004 NATA Position Statement concerning sports-related concussions?

- ◯ Yes
- ◯ No

Dear Certified Athletic Trainer,

I would like to thank you for your time in completing this survey. Your answers will be useful in analyzing current concussion evaluation and management skills of certified athletic trainers.

Sincerely,

Mark J. Tiemeier, ATC
San Jose State University

APPENDIX C
E-MAIL COVER LETTER

San José State University

College of Applied Sciences and Arts

Department of Kinesiology

One Washington Square
San José, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

Subject: Certified Athletic Trainers' Management of Sport-Related Concussions Survey

Dear Certified Athletic Trainer,

I am a master's degree candidate at San José State University, requesting your help to complete part of my degree requirements. Please follow the link at the end of this letter to an online survey entitled: Certified Athletic Trainer's Management of Sport-Related Concussions. This survey is not approved or endorsed by NATA. It is being sent to you because of NATA's commitment to athletic training education and research.

As a fellow certified athletic trainer, your knowledge and opinions regarding this topic makes your input invaluable. The questionnaire will take about five to seven minutes to complete.

One thousand randomly selected certified NATA members in the United States with a listed e-mail address are being asked to submit this questionnaire, but you have the right to choose not to participate. The San Jose Staté University Institutional Review Board has approved this study for the Protection of Human Subjects.

This is a completely anonymous questionnaire and upon submission, neither your name nor e-mail address will be attached to your answers. Your information will be kept strictly confidential. If you have any questions or concerns about this study, please feel free to contact me at (513)675-0732, or Leamor Kahanov, Graduate Athletic Training Education Program Director, at (408)924-3040. Complaints about the research may be presented to Dr. Shirley Reekie, Department Chair of Kinesiology at San Jose Staté University, (408)924-3010. Questions about a research subjects' right, or research-related injury may be presented to Pamela Stacks, Ph.D., Associate Vice President, Graduate Studies and Research, at (408)924-2427.

Please take a few minutes to fill out the anonymous questionnaire you will find by clicking on this link and submit it by February 1, 2009. By clicking on the survey link you have implied consent to participate in the research.

https://www.surveymonkey.com/s.aspx?sm=tc_2fsRRJf9PBbSXGoOnl7ew_3d_3d

Thank you for your time and consideration.

Sincerely,

Mark J. Tiemeier, ATC
San José State University
One Washington Square
San José, CA 95192
[redacted]

APPENDIX D

FOLLOW-UP E-MAIL

San José State
UNIVERSITY

College of Applied Sciences and Arts

Department of Kinesiology

One Washington Square
San José, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

Subject: Concussion Evaluation Skills of Certified Athletic Trainers Survey Follow-Up

Dear Certified Athletic Trainer,

I would like to thank you for your time in reading over the survey and information provided. Thanks to all of you who have responded to the survey as your help is appreciated.

I would like to ask again that those that have not filled out the survey, please take the small amount of time to explain your current concussion evaluation and management practices. I understand that your time is precious but your help is greatly appreciated.

Please take a few minutes to fill out the anonymous questionnaire you will find by clicking on this link and submit it by February 9, 2009. By clicking on the survey link you have implied consent to participate in the research.

https://www.surveymonkey.com/s.aspx?sm=eo_2fePRiff8PBbSXGcCHiew_3d_3d

Thanks again for your time,

Mark J. Tiemeier, ATC
San José State University
One Washington Square
San José, CA 95192
tiemeier_mj@yahoo.com

Participants for this survey were selected at random from the NATA membership database according to the selection criteria provided by the student doing the survey. This student survey is not approved or endorsed by the NATA. It is being sent to you because of NATA's commitment to athletic training education and research.

APPENDIX E

IRB Approval Form

San José State
UNIVERSITY

Office of the Provost
Associated Vice President
Graduate Studies & Research

One Washington Square
San Jose, CA 95192-0025
Voice: 408-924-2427
Fax: 408-924-2612
E-mail: gradstudies@sjsu.edu
http://www.sjsu.edu

To: Mark Tiemeier

From: Pamela Stacks, Ph.D.
Associate Vice President
Graduate Studies and Research

Date: December 4, 2008

The Human Subjects-Institutional Review Board has registered your study entitled:

"Certified athletic trainer's management of sport-related concussion"

This registration, which provides exempt status under Exemption Category 2, of SJSU Policy S08-7, is contingent upon the subjects included in your research project being appropriately protected from risk. This includes the protection of the anonymity of the subjects' identity when they participate in your research project, and with regard to all data that may be collected from the subjects. The approval includes continued monitoring of your research by the Board to assure that the subjects are being adequately and properly protected from such risks. If at any time a subject becomes injured or complains of injury, you must notify Dr. Pamela Stacks, Ph.D. immediately. Injury includes but is not limited to bodily harm, psychological trauma, and release of potentially damaging personal information. This approval for the human subject's portion of your project is in effect for one year, and data collection beyond December 4, 2009 requires an extension request.

Please also be advised that all subjects need to be fully informed and aware that their participation in your research project is voluntary, and that he or she may withdraw from the project at any time. Further, a subject's participation, refusal to participate, or withdrawal will not affect any services that the subject is receiving or will receive at the institution in which the research is being conducted.

If you have any questions, please contact me at (408) 924-2427.

Protocol # S0804175

cc. Leamor Kahanov, 0054