A comparison of concussion assessment and management protocols used by medical personnel at elite taekwondo tournaments in the Republic of Korea and the United States

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B Data Collection
C Statistical Analysis
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Abstract

Background and Study Aim: Little is known about the assessment and management protocols used by taekwondo tournament medical personnel to evaluate concussions. The purpose of this study was to compare the methods used by medical personnel in the Republic of Korea and the United States to assess and manage concussions sustained at elite taekwondo tournaments.

Material/Methods: Between 2006 and 2008, pencil-and-paper questionnaires were administered to 18 medical personnel providing sports medicine services at three national-level taekwondo tournaments in South Korea, and at one national-level taekwondo tournament in the United States.

Results: Four of 11 South Korean medical personnel (36%) held registered nursing (RN) credentials, four were physical therapists (36%), and three (27%) were emergency medical technicians (EMTs). In comparison, 2 of 7 American medical personnel were physicians (29%), two were certified athletic trainers (29%), two were EMTs (29%), and one was a physical therapist (14%). Of the South Korean medical personnel, 55% had less than 1 year experience serving as medical providers at taekwondo tournaments. In contrast, 71% of the American medical practitioners had greater than or equal to 5 years of experience serving as medical personnel at taekwondo tournaments, with the majority reporting greater than 10 years of experience at national level taekwondo tournaments. Both groups reported using symptoms checklists and clinical examination as their principal methods of concussion assessment.

Conclusions: We recommend that taekwondo national governing bodies assign medical personnel who have extensive direct experience with the sport of taekwondo to provide medical services at national-level tournaments.

Key words: taekwondo • concussion assessment • concussion management • appropriate medical personnel

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Background

In the Olympic sport of taekwondo the incidence of concussion has been reported to be up to four times greater than that found in American football and other contact sports [1,2]. A worldwide heightened awareness of the immediate dangers and long-term sequellae associated with sport-related concussions has led to the publication of consensus statements by the International Symposium on Concussion in Sport, the National Athletic Trainers' Association, and other medical groups to guide the clinical management of the athlete following concussion [3–6].

Concussion – a complex pathophysiological process that affects the brain, as induced by traumatic biomechanical forces.

Recently, greater responsibility has been placed on sports medicine practitioners with regard to the diagnosis and clinical management of sport-related concussions. In North America, only two studies have been published in the last decade with regard to the concussion assessment and management techniques practiced by athletic trainers [7,8]. The first report [7] of concussion management practices among certified athletic trainers (n=339) identified clinical examination (33%) and symptoms checklists (15.3%) as the two most common assessment methods. In this 2001 survey, the Colorado Medical Society (CMS) guidelines (28%) were being used more frequently for concussion management than other sets of guidelines, e.g., American Academy of Neurology, Cantu Guidelines. A more recent study [8] of 927 athletic trainers in the United States confirmed that a variety of techniques were being used to assess concussions, specifically, clinical examination (95%), symptoms checklists (85%), and the Standardized Assessment of Concussion (SAC) test (48%). Although the percentages of athletic trainers using clinical examinations and symptoms checklists to diagnose concussions differed widely between these two studies, the common theme emerged that athletic trainers were using standardized methods of care for athletes who sustained concussions [8].

Sideline Assessment of Concussion (SAC) test – Standardized concussion assessment tool used to assess concussion. Implementation requires baseline testing and is used immediately after the occurrence of a sport related concussion. The SAC measures concussion-related symptoms, postural control, and neurocognitive function.

ImPACT – Immediate Post-Concussion Assessment and Cognitive Testing is a validated computerized concussion evaluation system used to evaluate neurocognition before and after concussion. Areas of testing include attention span, working memory, sustained and selective attention time, response variability, non-verbal problem solving, and reaction time.

In taekwondo, a martial art in which high velocity kicks [9,10] to the head are an essential part of competition scoring, little is known about the concussion assessment and management protocols currently used by medical personnel at taekwondo tournaments. Therefore, the purpose of this study was to identify and compare the concussion assessment and management protocols used by medical personnel at elite taekwondo tournaments in the Republic of Korea (South Korea) and the United States. A secondary objective of this study was to gain further understanding of the medical qualifications and professional experience of personnel providing medical care at selected elite taekwondo tournaments.

Material and Methods

We administered questionnaires to a total of 18 taekwondo tournament medical personnel practicing in either South Korea (n=11) or the United States (n=7). This multi-year, cross-sectional, qualitative survey was conducted by administering questionnaires to medical personnel at three taekwondo tournaments in South Korea, specifically, at the 41st National President's Taekwondo Cup in 2006, the 2007 Elite Industrial Taekwondo Championship, and the 30th Korean National Collegiate Taekwondo Championships in 2007, and in the United States at the 2008 U.S. National Taekwondo Championships.

This study was approved for ethical adherence to the principles of the Declaration of Helsinki by the Institutional Review Board at Oregon State University (Corvallis, USA). Volunteers were given an oral description of the general scope of the study and all participants provided consent prior to administration of the questionnaire. Korean or English language versions of the questionnaire were provided to the participants as appropriate.

The questionnaire (Table 1) was designed to have participants quantify the extent of their personal experiences in providing medical care at taekwondo tournaments, as well as indicate the methods they currently used to assess and manage concussions. We employed frequency analysis and descriptive statistics to summarize the respondents' levels of professional experience in their respective medical fields, the number of years experience providing medical care at taekwondo tournaments, and the types of medical/allied health credential that the respondents held. Medical personnel were also asked to indicate whether they used any of 10 commonly used methods (Table 1) to assess and make return-to-play decisions for athletes who have sustained concussions, e.g., Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT), Sideline Assessment of Concussion (SAC) test.

Results

Four of the 11 Korean medical personnel surveyed (36%) held registered nursing credentials, while four were physical therapists (36%), and three (27%) were emergency medical technicians (Table 2). In comparison, the credentials of medical personnel at the 2008 U.S. National Taekwondo Championships included two physicians (MDs) (29%), two certified athletic trainers (29%), two emergency medical technicians (29%), and one physical therapist (14%) (Table 2).

Of the South Korean respondents, 55% (n=6) had less than one year of experience serving as a medical care provider at taekwondo tournaments, with 46% of the participants (n=5) indicating that the tournament in which this survey was conducted was the very first time he/she provided medical coverage at a taekwondo tournament (Table 3). Five of seven (71%) American respondents indicated that they had more than five years experience serving as medical personnel at taekwondo tournaments, with four of seven reporting that they had greater than 10 years experience at national level taekwondo tournaments (Table 3).

Six of the Korean medical personnel (55%) reported treating two or fewer concussions at taekwondo

Table 1. Sample questions from the taekwondo medical personnel questionnaire.

- **What medical/allied health credential do you possess?**
  - ☐ Physician (MD, DO)
  - ☐ Paramedic (EMT-P)
  - ☐ Chiropractor (DC)
  - ☐ Oriental medical doctor (OMD)
  - ☐ Emergency medical technician-Basic (EMT-B)
  - ☐ Certified athletic trainer (ATC)
  - ☐ Physical therapist/Physiotherapist (PT)
  - ☐ Emergency medical technician-Intermediate (EMT-I)
- **How long have you held this medical/allied health credential?**
  - ☐ ≤1 year
  - ☐ ≤7 years
  - ☐ ≤3 years
  - ☐ ≤9 years
  - ☐ ≤5 years
  - ☐ Other (please specify)
- **What is your current employment/position setting?**
  - ☐ College athletics
  - ☐ Professional athletics
  - ☐ High school athletics
  - ☐ Sports medicine clinic
  - ☐ General hospital setting
  - ☐ Academic Department
  - ☐ Fitness center
  - ☐ Personal Trainer
  - ☐ Corporate health
- **How long have you been working with taekwondo athletes?**
  - ☐ ≤1 year
  - ☐ ≤7 years
  - ☐ ≤3 years
  - ☐ ≤9 years
  - ☐ ≤5 years
  - ☐ Other (please specify)
- **Approximately how many concussions do you see per year at taekwondo tournaments?**
  - ☐ ≤2
  - ☐ ≤8
  - ☐ ≤4
  - ☐ ≤10
  - ☐ ≤5
  - ☐ Other (please specify)
- **Who is responsible for deciding whether an athlete can return to taekwondo competition following a concussion within your sports medicine team?**
  - ☐ Physician (MD, DO)
  - ☐ Paramedic (EMT-P)
  - ☐ Oriental medical doctor (OMD)
  - ☐ Emergency medical technician-Basic (EMT-B)
  - ☐ Chiropractor (DC)
  - ☐ Emergency medical technician-Intermediate (EMT-I)
  - ☐ Certified athletic trainer (ATC)
  - ☐ Other
  - ☐ Physical therapist/Physiotherapist (PT)
- **What methods do you use to assess and diagnose a concussion?**
  - ☐ Clinical examination
  - ☐ Standardized Assessment of Concussion (SAC)
  - ☐ Symptoms checklist
  - ☐ ImPACT
  - ☐ Balance Error Scoring System (BESS)
  - ☐ Neuropsychological testing (paper & pencil)
  - ☐ Concussion grading scales
  - ☐ Neuropsychological testing (computerized)
  - ☐ CogSport
  - ☐ Other (please specifiy)
- What methods do you use to determine when an athlete can return to play?
  - ☐ Clinical examination
  - ☐ Standardized Assessment of Concussion (SAC)
  - ☐ Symptoms checklist
  - ☐ ImPACT
  - ☐ Balance Error Scoring System (BESS)
  - ☐ Neuropsychological testing (paper & pencil)
  - ☐ Concussion grading scales
  - ☐ Neuropsychological testing (computerized)
  - ☐ CogSport
  - ☐ Other (please specifiy)

Table 2. Credentials of Personnel Responsible for Medical Care at Selected Elite Taekwondo Tournaments by Country: 2006–2008.

Credential/Certification	South Korea (n=11)	United States (n=7)
Registered Nurse (RN)	4	0
Physical Therapist (PT)	4	1
Medical Doctor (MD)	0	2
Certified Athletic Trainer (ATC)*	0	2
Emergency Medical Technician (EMT)	3	2

* A North American sports medicine credential issued by the Board of Certification, recognized by the National Athletic Trainers' Association (NATA) in the United States and the Canadian Athletic Therapists Association (CATA) in Canada.

tournaments within the past year. Four of seven (57%) American medical personnel surveyed indicated they had provided care for an average of 15 concussions at taekwondo tournaments within the past year; the remaining medical staff provided care for an average of three concussions within the past year. All South Korean and American medical personnel reported using two or more concussion assessment protocols, e.g., symptoms checklist, clinical evaluation (Table 4).

Discussion

Although all respondents possessed current professional medical certifications in their respective countries, there was a stark contrast between those providers employed at elite taekwondo tournaments in South Korea and the United States. Although the value of registered nurses (RNs) is understood within the practice of clinical medicine, such as that observed in hospitals and

Physical therapist (PT) – A licensed health care professional trained to assess, diagnose and treat a variety of health related illnesses through the use of manual therapy techniques, clinical modalities, and appropriate lifestyle changes.

Certified athletic trainer (ATC) – A North American sports medicine credential issued by the Board of Certification, recognized by the National Athletic Trainers' Association (NATA) in the United States and the Canadian Athletic Therapists Association (CATA) in Canada.

Table 3. Number of Years Experience Providing Medical Care at Elite Taekwondo Tournaments in South Korea and United States: 2006–2008. At the time they completed the questionnaire, 5 of 6 medical providers at South Korean elite taekwondo tournaments who had less than 1 year of experience indicated that this was their very first taekwondo tournament experience. Two of 7 medical providers at United States indicated the same.

Response to Question	American Respondents (n=7)		South Korean (n=11)	
Greater than 10 years with elite taekwondo tournaments	4	(57%)	1	(9%)
Greater than 5 years with elite taekwondo tournaments	1	(14%)	1	(9%)
Less than 1 year with elite taekwondo tournaments*	2	(29%)	6	(55%)
No response	0	(0%)	3	(27%)

Table 4. Evaluative Protocols/Methods Used in the Acute Assessment and Diagnosis of Concussions Sustained During Elite Taekwondo Tournaments in South Korea and the United States: 2006–2008.

Evaluative Protocols/Methods	South Korea (n=11)	United States (n=7)
Clinical Examination	5	7
Symptoms Checklist	6	6
*Balance Error Scoring System (BESS)	2	0
Concussion Grading Scales	1	2
*Sideline Assessment of Concussion (SAC)	0	5
Return to Play Guidelines	0	0
*ImPACT	0	0
Neuropsychological Testing (Paper/Pen)	0	0
Neuropsychological Testing (Computerized)	0	0
MRI/CT	0	0

* Indicates a standardized evaluation tool to assess various components of concussion symptoms and neurocognitive ability before and after concussion.

local clinics, the educational competencies of nurses differ greatly from those for sports medicine clinicians, e.g., athletic trainers and physical therapists.

The International Council of Nurses defines nursing as:

"Nursing encompasses autonomous and collaborative care of individuals of all ages, families, groups and communities, sick or well and in all settings. Nursing includes the promotion of health, prevention of illness, and the care of ill, disabled and dying people [11]."

This definition can further be understood through the curriculum of education outlined by the American Nurses Association that includes knowledge and skills related to adult acute and chronic diseases, maternal/child health, health assessment and pathophysiology [12]. It is understood that RNs may possess the ability to generally assess and treat acute musculoskeletal injuries in sport. However, utilization of medical professionals, e.g., physicians, athletic trainers physical therapists, who are specialists in the diagnosis and treatment of orthopedic injuries, as well as in the assessment and management of neurological injuries (concussions), must be taken into account by taekwondo governing bodies.

The need for specialized care for the concussed taekwondo athlete can be demonstrated through the responses received from the medical personnel sampled in our study. More than half (55%) of South Korean medical personnel reported that they treated less than two concussions per year. This small number may be a reflection of their medical knowledge of the diagnosis and clinical management of concussions, their relative inexperience in treating taekwondo athletes, or both. Forty-six percent of the South Korean medical personnel surveyed were first-time medical attendees at taekwondo events, and more than half of these medical providers (55%) had less than one year of experience with elite taekwondo tournaments.

Of the seven American respondents, 57% reported that they treated more than 15 concussions during the past year, a number that reflects the scope of their medical practices, as well as their aptitude in recognizing sport-related concussions. Our findings among American

medical personnel with regard to their experiences with diagnosis and clinical management of concussions are similar to those reported by previous studies published in the United States [7,8]. Notebaert and Guskiewicz [8] reported that less than 25% of the 927 certified athletic trainers who responded to their survey treated more than 10 concussions per year, with an average of 8.2±6.5 concussions assessed each year. Our findings, while from a much smaller sample than that obtained in Notebaert and Guskiewicz's [8] nationwide survey, indicate that medical personnel providing care at elite taekwondo tournaments in the United States assessed nearly twice as many concussions per year as did the typical certified athletic trainer in the USA. The number of concussions diagnosed per year by our American medical personnel are consistent with previously published reports of concussion incidences in taekwondo that are up to four times more frequent than in American football [1,2]. The large difference of the number of concussions assessed by our South Korean and American medical personnel highlights the importance of ensuring medical personnel employed at elite taekwondo competitions are well trained to identify, assess, and manage sport-related concussions. This difference in the number of concussions assessed and treated per year between the two groups of medical providers may be related to the type of medical credentials and clinical training possessed by the majority of South Korean taekwondo tournament medical personnel that we surveyed, i.e., registered nurses. Unfortunately the scope of the questions contained on our survey did not allow us to solicit information that we could use to answer this question conclusively. That being said, our data strongly suggest that medical personnel who possess more extensive clinical experiences with the diagnosis and management of concussions should be recruited to provide medical care at all elite, full contact taekwondo competitions in the Republic of Korea.

Conclusions

The medical personnel at elite taekwondo tournaments in South Korea and the United States who were surveyed over a 3-year period encountered substantially different numbers of concussions during tournament competition, a result that may be partially explained by differences in medical training and years of experience between the two groups. This study was the first to investigate concussion assessment and management protocols used by medical personnel at Olympic style taekwondo tournaments in South Korea and the United States. Although this study surveyed a relatively small sample of medical personnel, our results provide valuable insights into the trends of concussion management and level of medical care provided at full contact taekwondo competitions.

Future studies should endeavor to obtain data from a larger pool of tournament medical providers and sample a greater cross-section of the more than 200 member nations of the World Taekwondo Federation in order to gain a more complete understanding of the current techniques of concussion assessment and clinical management provided. In the interim, we recommend that taekwondo national governing bodies assign only medical personnel who have extensive, direct experience with the sport of taekwondo to provide medical care at national-level taekwondo tournaments. Given the heightened worldwide concern about long-term consequences for athletes who have sustained multiple concussions [13], taekwondo national governing bodies would do well to review current concussion management and assessment protocols used by medical personnel in their countries, and identify a standard of care for concussion assessment and management that accommodates the unique physical and neurocognitive demands placed on national-level taekwondo tournament competitors. In addition, sports medicine professionals, coaches, parents and national governing bodies must work cooperatively to ensure that all taekwondo athletes who suffer concussions follow standardized guidelines for the safe return to participation and/or tournament competition.

Highlights

To our knowledge, this is the first study to survey medical personnel at taekwondo competitions concerning medical practices used to assess and manage concussions during elite tournament competitions.

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References:

1. Zemper E, Pieter W: Cerebral concussions in Tae Kwon Do athletes. In: Hoerner EF (ed.). Head and Neck Injuries in Sports. Philadelphia: American Society for Testing and Materials, 1994; 116–23
2. Koh JO, Cassidy JD: Incidence study of head blows and concussions in competition Taekwondo. Clin J Sport Med, 2004; 14(2): 72–79
3. Guskiewicz KM, Bruce SL, Cantu RC et al: National Athletic Trainers' Association Position Statement: Management of Sport Related Concussion. J Athl Train, 2004; 39(3): 280–97

4. McCrory P, Meeuwisse W, Johnston K et al: Consensus statement on concussion in sport. The 3rd International Conference on Concussion in Sport held in Zurich, November, 2008; J Clin Neurosci, 2009; 16: 755–63
5. Yard EE, Comstock RD: Compliance with return to play guidelines following concussion in US high school athletes, 2005–2008. Brain Inj, 2009; 23(11): 888–98
6. NFL announces new sideline concussion assessment protocol. National Football League, Feb. 25, 2011 at 11:32 a.m. Date accessed site: Nov 16, 2011. Available from URL: www.nfl.com
7. Ferrara MS, McCrea M, Peterson CL, Guskiewicz KM: A survey of practice patterns in concussion assessment and management. J Athl Train, 2001; 36(2): 145–49
8. Notebaert AJ, Guskiewicz KM: Current trends in athletic training practice for concussion assessment and management. J Athl Train, 2005; 40(4): 320–25
9. Fife G, Pieter W, O'Sullivan D et al: Effects of Olympic style taekwondo kicks on an instrumented head-form and resultant head injury measures. Br J Sports Med, 2011; 45: 318–19
10. O'Sullivan D, Chung CS, Lee KK: Measurement and comparison of taekwondo and yongmudo turning kick impact force for two target heights. J Sport Sci Med, 2009; (8) (CSSI III): 13–16
11. International Council of Nurses. October, 2011. Available from URL: www.icn.ch
12. American Nurses Association. October 2011. Available from URL: www.nursingworld.org
13. McKee AC, Cantu RC, Nowinski CJ et al: Chronic Traumatic Encephalopathy in Athletes: Progressive Tauopathy following Repetitive Head Injury. J Neuropathol Exp Neurol, 2009; 68(7): 709–35