Sports chiropractic management of concussions using the Sport Concussion Assessment Tool 2 symptom scoring, serial examinations, and graded return to play protocol: a retrospective case series

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Abstract

Objective: The purpose of this case series is to report how the symptom section of the Sport Concussion Assessment Tool 2 (SCAT2) was used to manage athletes with concussions in a high school training room setting and to address the need for SCAT2 baseline measurements. **Clinical features:** During a 4-month period, 3 doctors of chiropractic with certification from the American Chiropractic Board of Sports Physicians managed 15 high school athletes with concussions in a multidisciplinary setting. Fourteen athletes were male American football players, and one was a female volleyball player.

Intervention and outcome: Of the 15 athletes, 3 athletes had baseline SCAT2 documentation. Athletes were evaluated and returned to play with a graded return to play protocol using the SCAT2 symptoms and serial physical examinations. Once participants were asymptomatic, they began a graded return to play process. A total of 47 SCAT2 tests were performed on the 15 athletes, averaging 3.13 SCAT2 evaluations per patient. Of the 15 athletes evaluated, 6 were managed and cleared for return to play; 2 of the athletes sustained concussions in the last week of the season, thus ending their season; and 3 athletes were cleared by medical doctors. None of the athletes under care reported an adverse event.

Conclusion: The utilization of the SCAT2 with serial physical examinations provided objective measures for athlete's injuries, allowing the practitioners to evaluate concussions.

At the time of the study, authors Shane, Pierce, and Gonzalez were sports residents at the Southern California University of Health Sciences (SCUHS) Sports Medicine Residency, Whittier, CA.

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More efforts are needed to collect baseline SCAT2 to compare these scores with subsequent SCAT2 scores following athletic injuries.

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Introduction

Concussions are a major concern in professional, collegiate, and high school sports.¹ There is a continuum of knowledge to be learned from the multiple professional fields and consensus statements being produced in an attempt to protect the athlete and prevent the negative long-term effects of concussion. Although agreement exists, the science of concussion is continually evolving; and at this time, management and return to play (RTP) decisions rely on the clinical judgment of the physician with an individualized approach for the athlete.²

Concussions are challenging to manage, and the complexity of each case should be considered on an individual basis using the clinical judgment of the practitioner. The Sport Concussion Assessment Tool 2 (SCAT2) was developed to replace the original Standardized Concussion Assessment Tool during the “3rd International Conference on Concussion in Sport” held in Zurich in November 2008. The SCAT2 is widely accepted as the standardized method to evaluate, assess, and manage concussions in athletes 10 years and older with the end goal of safely returning the athlete to play. The SCAT2 enables the calculation of the Standardized Assessment of Concussion score by evaluating 7 areas including symptoms, physical signs, Glasgow Coma Scale, sideline assessment using Maddocks score, cognitive assessment, balance, and coordination. The SCAT2 is designed for use by medical and health professionals. Preseason baseline testing with the SCAT2 can be helpful for interpreting postinjury test scores.²

At present, there are no reported studies of the use of the SCAT2 in a sports chiropractic setting. Therefore, the purpose of this case series is to report how the symptom section of the SCAT2 was used to manage a small group of athletes with concussions in a high school training room setting and to address the need for baseline measurements.

Case series

Use of SCAT2 and serial examinations

We chose to use the symptoms section of the SCAT2 with serial physical examinations to assess the athletes

because of the quickness and ease in which the symptom section was obtained. Without a baseline SCAT2 on every athlete, the scoring system in several sections including cognition and balance is relative. Furthermore, the total point scoring system of the SCAT2 did not seem appropriate to the authors for use for RTP because of scoring issues. For example, if an athlete loses consciousness, only 1 point is deducted from the total score. Therefore, an athlete that loses consciousness could still achieve a possible score of 99/100. We felt it unreasonable to return an athlete based on this score alone. The SCAT2 designates 15 possible points to the Glasgow Coma Scale. This allows a nonbreathing person without a pulse to score 3 points on the scale. Moreover, the Maddocks Sideline Assessment totals 5 points and is only applicable if the initial test was performed at the time of injury. Given these scoring values, the total scoring system did not seem appropriate. By using the symptoms section in addition to physical examination, management, tracking, and returning athletes to play through a graded RTP process were simplified.

Participants

These retrospective medical record review and report were approved by the institutional review board of the Southern California University of Health Sciences, and consent was obtained. The participants for this study came from a local high school and participated in fall sports, football, and volleyball. Before beginning the school year and fall practices, 3 doctors of chiropractic (DCs) who were board certified in sport chiropractors along with a medical doctor specializing in obstetrics and gynecology administered preparticipation physical examinations wherein 80 baseline SCAT2 forms were obtained.

During the fall season, the injured athletes voluntarily came to the training room at the high school and reported concussion-like symptoms to the doctor on site. All these athletes experienced some form of traumatic injury including blows to the head or body causing them to experience symptoms of mild traumatic brain injury. The student athletes ranged from 13 to 17 years of age. There were 14 male American football players and 1 female volleyball

player. Of the 15 athletes, 5 were freshman, 3 were sophomores, 3 were juniors, and 4 were seniors.

The team positions of the male athletes were as follows: 11 offensive football players, 7 defensive players, and 4 athletes who played on both offense and defense. The 1 female athlete was a serving specialist.

Once the athlete presented to the training room with concussion-like symptoms, a SCAT2 form was administered with emphasis placed on the patient's reported symptoms. Once the symptoms and cognitive sections were administered, the athlete was educated concerning his or her head injury. Upon completion of a physical examination and the SCAT2 wherein a concussion was diagnosed, the athlete's parents were given a form that detailed the symptoms to look for, which may be indicative of a more serious head/brain injury (ie, increasing headache, nausea/vomiting, seizures). If any of those symptoms presented, the athlete and the parents were instructed to immediately report to the emergency department. Concussion education is important in sports medicine, and it is recommended that education should be directed toward the athletes and their families (Appendix A).⁷

The athletes were told to report back to the training room the next day to follow up on their symptoms. Once they returned, a subsequent SCAT2 was administered. Some athletes chose not to be reexamined, whereas some athletes delayed their reexamination by several days, thus the reason why not all athletes had the same number of SCAT2 evaluations. Once the athlete was asymptomatic at rest, the athlete began a graded RTP protocol. The 6-stage protocol was as follows: rest until asymptomatic, light aerobic activity, sport specific exercise, noncontact training, full-contact training, and then return to competition.

Following a period of physical and cognitive rest, the athletes became asymptomatic; and light aerobic activity was begun. If the athletes responded well to 15 minutes of light aerobic activity, they were progressed the following day to moderate aerobic activity for 25 minutes. The next step was sport-specific exercise, which included going out to the football field or volleyball court and doing shuttle drills, route running, and running through their roles and responsibilities on various plays. The athletes were then progressed to practice without contact if still asymptomatic. The final step before returning the athletes to play was allowing the athletes to complete a full practice routine with contact.² If the athletes showed symptoms at any point during this process, they would have been returned to the previous step. However, in this study, no athlete experienced symptoms during this process.

Once the athletes were determined to be asymptomatic at rest and through all stages of the RTP protocol, they were cleared and returned to play. No athlete was cleared to play by any of the 3 sport DCs unless he or she was asymptomatic at rest and through full activity. The SCAT2 forms and daily clinical notes were used to document and demonstrate these findings. There was no other treatment rendered except for recommendation of cognitive and physical rest. All of the athletes were afforded the opportunity to see an outside medical provider, of which 3 did (#1, #5, and #6).

Outcomes

Of the 15 athletes with concussions, 3 were cleared by outside medical professionals (#1, #5, #6); 2 had concussions in the last week of the season, thus ending their season (#10, #14); and 10 were managed by the DCs (Table 1). Of the 3 cleared by outside medical practitioners, 2 were still symptomatic; and 1 had a flare-up of symptoms, causing him to miss an additional 13 days. This athlete transferred schools following the second bout of symptoms; and accordingly, no follow-up was obtained. Two of the athletes underwent advanced imaging in the form of a computed tomographic scan; the results of both of these studies were negative for pathology.

Upon administering the first SCAT2, the most commonly reported symptom of all 15 athletes was "feeling slowed down." Fourteen of the 15 athletes experienced headaches, which were the second most common symptom. The third most common symptom reported was a vague symptom of "something doesn't feel right." The least common symptoms for the first evaluation were trouble falling asleep and sensitivity to light (Fig 1). Symptom occurrences were observed to decrease over each subsequent examination (Fig 2).

The average number of symptoms reported on the first evaluation was 12.33, and the average severity was 43.33. There were 2 outliers on the first SCAT2; 1 athlete reported all 22 symptoms with a severity of 99/132, and the second athlete reported 1 symptom at a severity of 2. The athlete with all 22 symptoms and a reported severity of 99 was first evaluated 2 weeks after the initial injury.

Thirteen athletes underwent a second SCAT2 evaluation, with an average of 6.53 symptoms present and an average severity of 16. Seven athletes had a third SCAT2 administered, with an average of 8.57 symptoms present and an average severity of 20.29.

The average number of symptoms for the fourth SCAT2 was 5.714, and the average severity was 13.87. The fifth SCAT2 series averaged 1.33 symptoms with a

Table 1 Number of symptoms and SCAT2 symptom severity scores from multiple evaluations

Athlete #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Initial score															
Total # of symptoms	14	13	13	9	15	17	8	22	20	6	10	8	12	17	1
Symptom severity score	55	57	54	22	50	57	11	99	72	10	39	21	25	76	2
Second evaluation															
Total # of symptoms	4	x	1	0	7	19	6	20	1	0	1	x	9	16	1
Symptom severity score	5	x	2	0	15	46	7	78	1	0	1	x	15	37	1
Third evaluation															
Total # of symptoms	9	x	x	x	4	19	7	19	1	x	x	x	x	x	1
Symptom severity score	29	x	x	x	8	46	9	48	1	x	x	x	x	x	1
Fourth evaluation															
Total # of symptoms	14	x	x	x	7	15	1	3	0	x	x	x	x	x	0
Symptom severity score	49	x	x	x	14	30	1	3	0	x	x	x	x	x	0
Fifth evaluation															
Total # of symptoms	1	x	x	x	4	x	0	x	x	x	x	x	x	x	x
Symptom severity score	1	x	x	x	7	x	0	x	x	x	x	x	x	x	x
Sixth evaluation															
Total # of symptoms	x	x	x	x	4	x	x	x	x	x	x	x	x	x	x
Symptom severity score	x	x	x	x	4	x	x	x	x	x	x	x	x	x	x

x = not present or athlete did not need to report.

severity of 2.67. Only 1 athlete had a sixth SCAT2 administered, reporting 2 symptoms both at a severity of 1. Scores from the initial visit and summary of changes in scores over time can be seen in [Tables 2 and 3](#). None of the athletes under care during this season reported an adverse event.

Discussion

At the time these athletes were managed, the leading document in concussion is the “Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport Held in Zurich

Fig 1. Overall symptom frequency for 15 athletes with concussion.

Fig 2. Symptom occurrence over 6 clinical visits.

November 2008.” According to the Zurich Consensus Statement, *concussion* is defined as “A complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces. Several common features that incorporate clinical, pathologic and biomechanical injury constructs that may be

utilized in defining the nature of a concussive head injury include:

1. Concussion may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an ‘impulsive’ force transmitted to the head.

Table 2 SCAT2 scores from the initial visit

Athlete #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Ave severity	Total occurrence/15
Headache	5	4	4	3	2	6	2	4	6	1	5	3	4	6	0	3.67	14
"Pressure in head"	4	0	5	2	4	6	3	4	5	0	5	3	3	0	0	2.93	11
Neck pain	6	0	2	3	0	0	0	5	2	4	0	0	0	4	0	1.73	7
Nausea or vomiting	4	4	0	0	0	3	1	4	0	0	0	3	2	3	0	1.60	8
Dizziness	4	2	3	0	3	6	1	5	4	1	0	0	1	0	0	2.00	10
Blurred vision	0	0	0	0	3	0	1	5	5	0	3	0	0	3	0	1.33	6
Balance problems	3	0	4	0	3	4	0	4	1	0	0	0	0	4	0	1.53	7
Sensitivity to light	0	0	0	0	0	1	0	4	2	0	0	0	0	5	0	0.80	4
Sensitivity to noise	1	5	3	0	4	0	0	3	0	0	4	0	0	5	0	1.67	7
Feeling slowed down	4	6	5	2	4	3	1	5	2	2	5	2	2	5	2	3.33	15
Feeling like "in a fog"	0	0	5	0	3	0	0	4	2	0	3	0	0	5	0	1.47	6
"Don't feel right"	6	5	6	3	4	3	1	6	5	0	3	3	2	5	0	3.47	13
Difficulty concentrating	4	3	6	2	2	1	0	5	5	0	3	2	3	4	0	2.67	12
Difficulty remembering	5	2	2	4	0	1	0	3	3	0	0	0	1	4	0	1.67	9
Fatigue or low energy	3	6	5	1	4	2	0	5	2	0	3	3	4	5	0	2.87	12
Confusion	4	0	0	2	2	1	0	5	3	0	0	0	1	5	0	1.53	8
Drowsiness	0	6	4	0	3	4	0	5	3	1	5	0	1	5	0	2.47	10
Trouble falling asleep	0	6	NA	0	NA	NA	NA	4	6	0	NA	0	0	0	0	1.60	3
More emotional	0	3	0	0	0	5	0	5	4	0	0	0	0	3	0	1.33	5
Irritability	2	5	0	0	0	6	1	5	6	0	0	0	1	5	0	2.07	8
Sadness	0	0	0	0	5	3	0	4	3	1	0	0	0	0	0	1.07	5
Nervous or anxious	0	0	0	0	4	2	0	5	3	0	0	2	0	0	0	1.07	5
Sx severity score	55	57	54	22	50	57	11	99	72	10	39	21	25	76	2	43.33	
Total number of sx	14	13	13	9	15	17	8	22	20	6	10	8	12	17	1	12.33	185

Ave, average; NA, not applicable; Sx, symptoms.

Table 3 Summary of SCAT2 scores over 6 visits

	1st eval: 15	2nd eval: 13	3rd eval: 7	4th eval: 7	5th eval: 3	6th eval: 1	All evals
Total # of sx	185	85	60	40	4	2	376
Ave # of sx	12.333	6.53846	8.57	5.714	1.333	2	8.1739
Max # of sx	22	20	19	15	3	2	22
Min # of sx	1	0	1	0	0	2	0
Ave severity score	43.333	16	20.286	13.857	2.667	2	24.06521739
High severity score	99	78	48	49	7	2	99
Low severity score	2	0	1	0	0	2	0
	Initial evaluation	Evaluation 2	Evaluation 3	Evaluation 4	Evaluation 5	Evaluation 6	

Ave, average; eval, evaluation; Sx, symptoms.

2. Concussion typically results in the rapid onset of short-lived impairment of neurologic function that resolves spontaneously.
3. Concussion may result in neurological changes, but the acute clinical symptoms largely reflect a functional disturbance rather than a structural injury.
4. Concussion results in a graded set of clinical symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive symptoms typically follows a sequential course; however, it is important to note that, in a small percentage of cases, post-concussive symptoms may be prolonged.
5. No abnormality on standard structural neuroimaging studies is seen in concussion.”²

Sports medicine professionals use the Immediate Post Concussive Assessment and Cognitive testing (ImPACT) as a tool to assess a baseline and track current postconcussive symptoms. The ImPACT test is a computerized concussion evaluation that is designed to assess the neurocognitive status of concussed athletes. Schatz et al³ published an article on the use of ImPACT testing to correctly diagnose concussed athletes in a 2006 study. However, there is limited research supporting sideline management and RTP using the SCAT2. A recent article, “Sport Concussion Assessment Tool-2: Baseline Values for High School Athletes,” from the *British Journal of Sports Medicine* (2012) found that “Non-concussed high school athletes scored near the total possible in most domains of the SCAT2 with the exception of concentration testing and balance testing.”⁴ Jingui et al⁴ demonstrated the need for SCAT2 baseline cognitive testing with their research findings; 67% of the nonconcussed high school athletes could recite the months of the year in reverse, and 41% were able to complete the 5 digits in reverse correctly. They also found that older high school students experienced 2 or 3 symptoms at baseline testing. Baseline values can be effective in

tracking postconcussive symptoms and guiding RTP, especially if, before the injury, the athlete normally exhibits any of the 22 symptoms. Meehan and Bauchur⁵ also acknowledge that athletes do not always report concussion or concussion-like symptoms because they do not believe it is serious or do not relate the symptoms to the injury. McCrory et al⁶ note that concussion symptoms show no significant difference between adults and adolescents, but cognitive deficits tend to last longer in adolescents as compared with adults.

Research suggests the reported rate of concussions is quite different than the actual number of concussions obtained. Cantor et al⁸ found concussed individuals have insomnia as well as fatigue; our study supported these findings, with fatigue and low energy being one of the most reported symptoms upon initial evaluation. In 2 previous studies, the symptom scoring was deemed more appropriate for diagnosing concussions in adolescents compared with children.^{9,10}

In our retrospective case series, we observed that over a period of cognitive and physical rest, the number of symptoms and severity decreased in those athletes adhering to the graded RTP protocol. By allowing the concussed athletes to rest until asymptomatic, then gradually returning them to play, the athletes were able to RTP without symptoms returning. Educating school administration, coaches, parents, and athletes is an important factor in the future of more fully understanding and managing concussions and the resulting sequelae.⁷

Limitations

The major limitation was the lack of baseline SCAT2 scores for all athletes. Of the 15 assessed athletes, only 3 had baseline studies despite a total of 88 baseline SCAT2 athlete forms being on record from the preparticipation physicals. Establishing an individual's baseline score is critical for the evaluation of symptoms as well as assessing neurocognitive function for the athlete after a concussion. Without baseline studies, cognitive testing

and balance testing are both relative. Moreover, without a baseline study, it is challenging to determine whether the symptoms were due to the concussion or unrelated conditions. Therefore, further research with baseline testing is crucial to safely manage athlete's RTP.

It is likely that some athletes with concussion were missed, as it is unknown how many athletes had concussion during this period of supervision. Athletes who may have had a concussion and did not report to the training room were not evaluated or assessed. Some athletes in this study did not attend school immediately following their concussion; and therefore, immediate follow-up examinations could not be obtained. This study was also limited to the number of athletes the sports medicine chiropractors were responsible for evaluating and treating during the study's time frame.

Finally, compliance to the recommendation of both physical and cognitive rest was challenging given that these athletes were all high school students. Although cognitive and physical rest was prescribed to every athlete, the athletes in this study were not able to achieve complete cognitive rest because they continued to attend school daily. There was no long-term follow-up with these athletes regarding symptoms, and it is possible that athletes did not report all symptoms. Only the symptom portion of SCAT2 in addition to serial physical examinations was used in this protocol. In the future, use of the full SCAT2 should be considered.

Future recommendations

Additional research using the complete SCAT2 form and implementing baseline studies is needed. This study demonstrates that these methods can be used in a sports chiropractic setting and provides a starting point for using the SCAT2 to recognize the most commonly reported symptoms and the average severity of such symptoms. This study also demonstrated that, by using symptom scoring and a graded RTP process, a board-certified sports DC can safely and effectively return concussed athletes to play. Further concussion research in similar settings is needed to grow evidence-based knowledge of concussions and how to safely return athletes back to sport.

Conclusion

The utilization of the SCAT2 symptoms with serial physical examinations and clinical judgment provided outcomes for DCs with sports specialties to manage head injuries and concussions in high school athletes.

Over the course of 3 months, a graded RTP protocol was used to return concussed athletes to competition; none of the athletes under care reported an adverse event.

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Appendix A. Concussion Information Sheet

You have just sustained a traumatic brain injury (concussion), which is a very serious injury and needs to be monitored. A concussion is violent shaking or jarring action of the brain resulting in immediate or transient impairment of neurological function. Concussion and the resulting complications, such as second-impact syndrome, are potentially life-threatening situations. There are various signs and symptoms of a head injury that may show up immediately or several hours after initial injury. A follow-up evaluation is needed before returning to practice or play.

- Headache
- Neck pain
- Nausea
- Vomiting
- Loss of appetite
- Balance problems/dizziness
- Drowsiness/fatigue
- Difficulty sleeping
- Nervousness/anxiety
- Sensitivity to light/noise
- Continued double vision
- Altered emotion/behavior
- Ringing in the ears
- Feeling “slowed down”
- Feeling like you’re in a “fog”
- Difficulty concentrating or remembering
- Confusion/disorientation
- Blurred vision
- Sadness/altered emotions

Follow the instructions below:

- Rest and avoid strenuous activity for at least 24 hours
- Do NOT take aspirin or other anti-inflammatory medication
- Do NOT consume alcohol
- Do NOT use sleeping medication
- Tylenol may be used
- Do not drive until medically cleared
- Do not train or play sport until medically cleared

Watch for any of the following:

- Worsening headache
- Vomiting
- Decreased level of consciousness
- Dilated pupils
- Increased confusion
- Stumbling/loss of balance
- Weakness in one arm/leg
- Blurred vision
- Increased irritability

If these symptoms worsen, or if any of the additional symptoms appear report to the emergency department.