REVIEW ARTICLE

Assessing the Immediate Effect of Osteopathic Manipulation on Sports Related Concussion Symptoms

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Background: Osteopathic manipulative therapy has been reported to improve dizziness and neck pain, which are symptoms commonly seen in concussion. Conceivably OMT could be used to treat similar symptoms secondary to concussion. To our knowledge there has not been any studies that linked OMT to the reduction of concussive symptoms. **Objective:** To retrospectively examine the effect of OMT in reducing concussive symptoms in athletes. **Methods:** Records included in this retrospective chart review were those that had a diagnosis of concussion sustained during athletics and required that the patient had completed the symptom checklist found on the Standardized Concussion Assessment Tool (SCAT2) prior to the visit as well as completing another SCAT2 symptom checklist following OMT. Scores from each patient's pre-treatment SCAT2 assessment were then compared to their post-treatment scores. **Results:** A total of 26 patient charts met selection criteria and were included in this retrospective study. Summary descriptive statistics were generated. Paired sample t-tests revealed that OMT improved each of the 22 self-reported symptoms listed on the SCAT2, with 10 symptoms (45.4%) demonstrating statistically significant improvement ($p<.05$). These symptoms included: headache, pressure in head, blurred vision, sensitivity to light, feeling in a fog, don't feel right, difficulty concentrating, fatigue or low energy, irritability, and sadness. **Conclusion:** OMT was effective at reducing overall symptoms related to concussion. A substantial subset of concussive symptoms on the SCAT2 had significant reduction with the use of OMT. The integration of OMT into concussion management appears to immediately reduce symptom burden.

INTRODUCTION

Concussion has become an increasingly common and pervasive injury associated with high energy sports such as football and soccer. Large numbers of athletes who participate in such sports at the professional, collegiate, or even high school level- suffer from concussive injury. The Centers for Disease Control and Prevention reported that out of the 2.5 million concussions that occurred in the United States in the year 2010, 300,000 occurred from sports and recreational activities.[1,2] Sport-related concussions present clinicians with unique challenges regarding diagnosis, treatment and return to play decisions.[3,4]

Numerous factors unique to the patient, such as age, gender, prior history of concussion and other preexisting neurological or psychosocial conditions, can affect diagnosis, prognosis and treatment.[5] A current deficit in the medical community is that no gold standard has been established concerning the diagnoses and management of concussion.[6] The Standardized Concussion Assessment Tool (SCAT) is currently used by sports clinicians for the diagnosis and management of sport related concussion. The second edition of the SCAT (SCAT2) is divided into eight components that assess severity of symptoms, cognition, balance, neurological signs and the Glasgow Coma Scale.[6] The symptom assessment portion is comprised of 22 symptoms measured by a 7 point Likert scale. Most commonly reported symptoms following concussion include headache, dizziness, neck pain and nausea.[7] The 4th international conference on concussion in Zurich, Switzerland stated that a concussion is caused by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head.[8] Impulsive impacts transmitted through the body to the head or from the head to the body can result in an array of somatic and vestibular dysfunction.

Treatment of vestibular dysfunction and dizziness with osteopathic manipulation and vestibular rehabilitation has been shown to be helpful at improving impairments in eye-head coordination, standing static balance, and ambulation.[9] Dizziness is also a common complaint without history of impact or concussion and has been treated successfully with osteopathic manipulative therapy (OMT).[10, 11, 12] OMT has been shown to be useful at treating cervical somatic dysfunction, neck pain, and balance difficulties, which are all commonly reported symptoms following concussion.[10] Conceivably, OMT could be useful at treating symptoms related to concussion.

Presently, the recommended management of concussion includes a period of physical and cognitive rest immediately

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following the injury and a graded program of physical exertion once symptoms have subsided.[5] No consensus has been reached on whether rest and light exercise are beneficial to the athlete's return to play progression. However, recent literature suggests that individualized treatment of symptoms may reduce time lost due to concussion.[5] The majority of concussions (80%-90%) resolve in 7-10 days with 10%-15% persisting longer.[6] It has been recommended that sport related concussions in which symptoms persist longer than 10 days be managed in a multidisciplinary manner.[6] OMT has the potential to be easily integrated into existing concussion treatment and management plans. Thus the question explored in this study became: Did OMT reduce symptom burden? If symptom burden prevents progression to a graduated return to play protocol then reduction of that burden may result in a quicker return to play.

OBJECTIVE

To examine the effectiveness of OMT at reducing concussive symptoms in athletes who were diagnosed with a concussion.

HYPOTHESIS

OMT is effective at reducing symptoms related to concussion

MATERIALS AND METHODS

DESIGN

This study was a retrospective chart review of cross-sectional medical information collected on symptomatic athletes diagnosed with concussion during a visit to the physician's sports medicine practice. Institutional Review Board (IRB) permission was obtained to review patient records.

SETTING

All charts contained data on patients who were evaluated at the physician's main office and the athletic training facility at Ohio University. Both are located in Athens, Ohio.

POPULATION/SAMPLE

Each patient whose chart was selected was a high school or collegiate athlete in a small Midwestern community. These athletes were involved in high energy sports and diagnosed with concussion. Twenty-six charts were extracted from the spring sport season of 2013 and fall sport season of 2013.

INCLUSION AND EXCLUSION CRITERIA

All data from charts are representative of athletes who were evaluated and treated for a sports-related concussion. In order to be considered, the patient must have completed the SCAT2 symptom checklist prior to physician evaluation, received osteopathic manipulation and filled out another SCAT2 symptom checklist following the physician encounter. All chart data without a completed pre and post-treatment SCAT2 symptom checklist or a non-sports related concussion were excluded from the review.

INSTRUMENTS

The SCAT2 was used to assess concussion symptoms. The SCAT2 is a standardized assessment tool that measures self-reported symptoms and neurocognitive functioning following a suspected concussion. Each patient evaluated was asked to complete the symptom log that contains 22 symptoms commonly seen in concussed individuals. The log prompts the patient to rank each symptom on a 0-6 scale with 0 being no symptoms and 6 being severe symptoms. Self-reported scores were obtained as literature suggests that self-reported scores are more consistent than if the patient were asked about their symptoms in an interview style.[13, 14] The SCAT2 symptom list is shown in Appendix 1 (page 34).

PROCEDURE

Each patient chart contained a subjective portion of the SCAT2 that was completed upon arrival for an appointment with the physician. During the course of the evaluation, each patient was treated with osteopathic manipulation by the physician or by one of two OMM/NMM Plus-One Residents under the direct supervision of the physician. Osteopathic treatments were individualized based upon the patient's complaint and location of somatic dysfunction. Osteopathic techniques used to treat somatic dysfunction was left to the discretion of the treating practitioner but included both direct and indirect technique. At the close of the appointment the patient was asked to fill out another SCAT2 symptom checklist which was placed in the chart. Once data was collected the pre-treatment scores were compared to post-treatment scores to determine whether osteopathic manipulation had an effect on the participants' SCAT2 scores.

DATA ANALYSIS

Summary descriptive statistics (mean, standard deviation, and range) were generated for continuous variables such as age and the number of days post-injury treatment occurred. Furthermore, descriptive statistics were generated for SCAT2 scores pre and post OMT. Frequencies were generated for the categorical variable, gender. Paired sample t-tests were used to determine pre-post differences in the SCAT2 scores for each of the symptoms as well as an overall summative SCAT2 symptom score. Where appropriate a chi-square test of proportions was used. Statistical significance was set at $p < .05$.

RESULTS

In all, 26 records of athletes met the inclusion criteria. Complete data on gender was available on 25 patients—there was one missing data point for gender. Out of the 25, 16 (64%) were male while 9 (36%) were female. Participants' average age was 19.56 (± 2.873 s.d.) years with a range of 15 to 26 years. Post-injury to treatment period was on average 6.50 (± 4.926 s.d.) days with a range of 1 to 19 days (Table 1). When post-injury period was categorized for the 20 records for which data was recorded, 12 (60%) had post injury time of seven days or less and 8 (40%) had higher than seven days. However, these proportions of patients were not significantly different with respect to the post-injury time categories, $p= .371$.

All the SCAT2 score differences (post minus pre) of the 22 symptoms had a negative sign indicating that the self-reported pre-treatment scores were higher than the reported post-treatment scores. This suggested that treatment (OMT) provided improvement for all symptoms. However, statistically significant improvements were observed in 10 out of the 22 (45.4%) symptoms as well as the overall summative symptoms score of the SCAT2 listed in Table 2. Table 2 provides a summary of the statistically significant ($p<.05$) SCAT2 symptoms scores.

TABLE 1

Age and Number of Days Post-Injury of Patients

	N	Min	Max	Mean	Standard Deviation
Age	25	15	26	19.56	2.873
Number of days post injury	20	1	19	6.50	4.926

TABLE 2

Mean Differences, Standard Errors, Confidence Intervals, and p-Values of the Statistically Significant SCAT2 Symptom Scores

Symptom	Mean Difference (post - pre score)	Standard Error of Mean Difference	95% Confidence Interval		p-value (2-tailed)
			Lower	Upper	
Headache	-0.731	0.226	-1.196	-0.266	.003
Pressure in head	-0.615	0.229	-1.087	-0.143	.013
Balance problems	-0.462	0.194	-0.861	-0.062	.025
Sensitivity to noise	-0.615	0.193	-1.012	-0.218	.004
Feeling like in a fog	-0.731	0.219	-0.280	-3.340	.003
Don't feel right	-0.615	0.272	-1.176	-0.055	.033
Difficulty concentrating	-0.808	0.309	-1.444	-0.171	.015
Fatigue or low energy	-0.615	0.208	-1.044	-0.187	.007
Irritability	-0.462	0.194	-0.861	-0.062	.025
Sadness	-0.500	0.224	-0.961	-0.039	.035
Overall symptom	-10.846	3.769	-18.608	-3.085	.008

Conversely, the non-statistically significant pre-post differences in symptom scores are shown in a table in Appendix 2 (page 35). While the differences were not statistically significant, they all had a negative sign, which implied that there was a reduction in the severity of the symptoms reported following OMT. The SCAT2 scale ranged 0-6 where 0 signified no symptom and 6 signified severe symptoms. Hence, a negative difference between post- and pre- scores would suggest a diminution in reported severity of symptoms following the use of OMT as a treatment intervention.

COMMENT

To our knowledge, this is the first reported study of its kind to examine the effects of OMT on concussive symptoms. Many symptoms listed on the SCAT2 are common to other medical conditions and have been shown to be treated effectively with OMT. In this study, all 22 symptoms trended toward improvement immediately following OMT. There was a subset of symptoms that showed significant improvement as shown in Table 2.

Our hypothesis that OMT results in a reduction of concussion related symptoms as recorded by concussed athletes on the SCAT2 was substantiated by the data. Furthermore, OMT significantly improved a subset of 10 symptoms as reported by the SCAT2 scores. Therefore, it is feasible that stratification of patients into treatment groups, such that those patients presenting with symptoms most responsive to osteopathic manipulation, would receive the greatest benefit from OMT. Patients with symptoms that do not show significant improvement with OMT could then be effectively managed by standard treatment protocols.

Although encouraging, this retrospective study had the limitation of a small data set. It did not take into account patient randomization into a treatment group, a control group or a sham treatment group. As there was not a control group that did not receive OMT, we cannot conclude that the positive changes observed were secondary to OMT. Furthermore, this study also involved the results from multiple treating physicians. The multiple physicians involved in providing the OMT could provide variability in the treatments that was not accounted for. Future studies should have a single osteopathic physician to reduce variability in OMT techniques. Although a formal protocol would have created a uniform treatment, it is important to note that variability coincides with the theories of osteopathic medicine, which is to resolve structural imbalances to improve overall function of the body.[10] In future studies, it may be useful to record the location and severity of somatic dysfunction in order to determine patterns as they relate to concussion. This could potentially help determine treatment protocols, which could then be implemented by clinicians treating concussion.

Results suggest that a certain subset of concussive symptoms can be immediately reduced with individualized OMT. One encouraging outcome was the fact that quite a number of symptoms were significant despite the small sample size. Notably, it would be expected that a higher number of symptoms to be significant with a larger sample size. Although, there are certainly limitations, the results appear promising and should provide a starting point for further research on OMT as an option in the concussion treatment repertoire. Such studies are becoming increasingly more important and necessary secondary to the paucity of recommended treatment options for concussion.

CONCLUSION

The use of OMT following concussion had a positive impact on symptoms as measured by SCAT2 symptom scores. The impact of OMT in reducing the burden of concussive symptoms was significant for 10 of the 22 symptoms on the SCAT2. Future prospective studies are needed to provide more compelling evidence of the effectiveness of OMT in the management of concussive symptoms. Implementing OMT into the management of concussive symptoms decrease the overall symptom burden experienced by the athlete, which may result in a timely return to activity.

REFERENCES

1. National Hospital Discharge Survey (NHDS), 2010; National Hospital Ambulatory Medical Care Survey (NHAMCS), 2010; National Vital Statistics System (NVSS), 2010. All data sources are maintained by the CDC National Center for Health Statistics.
2. McCrory P, Meeuwisse W, Johnston K, et al. Consensus statement on concussion in sport. 4th International Conference on Concussion in Sport Held in Zurich, November 2012. Clin J Sport Med. 2013;23:89–117.
3. Alsalaheen BA , Whitney SL , Mucha A , Morris LO , Furman JM , Sparto PJ . Exercise prescription patterns in patients treated with vestibular rehabilitation after concussion. Physiother Res Int. 2013 ; 18 (2): 100 – 108.
4. Fraix, M, Gordon, A, Graham V, Hurwitz E, Seffinger, M. A. Use of the SMART balance master to quantify the effects of osteopathic manipulative treatment in patients with dizziness. J Am Osteopath Assoc. 2011;113(5):394-403.
5. Faul M, Xu L, Wald MM, Coronado VG. Traumatic brain injury in the United States: Emergency department visits, hospitalizations, and deaths. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. 2010.
6. Fraix M. Osteopathic manipulative treatment and vertigo: a pilot study. PM&R. 2010;2(7):612-618.
7. Lopez D, King H, Knebl J. Effects of comprehensive osteopathic manipulative treatment on balance in elderly patients: a pilot study. J Am Osteopath Assoc. 2011;111(6):382-388.
8. Schneider KJ, Iverson GL, Emery CA, et al. The effects of rest and treatment following sport-related concussion: a systematic review of the literature. Br J Sports Med. 2013;24:91–92.

9. Iverson GL, Brooks BL, Ashton VL, et al. Interview versus questionnaire symptom reporting in people with the postconcussion syndrome. J Head Trauma Rehabil. 2010;25:23–30.

10. Krol AL, Mrazik M, Naidu D, et al. Assessment of symptoms in a concussion management programme: method influences outcome. Brain Inj. 2011;25:1300–1305.

11. Mayers LB. Outcomes of sport-related concussion among college athletes. J Neuropsychiatry Clin Neurosci. 2013;25(2):115119.

12. Institute of Medicine. Sports-related concussions in youth: Improving the science, changing the culture. Report Brief. 2013. Available at http://www.iom.edu/~/media/Files/Report%20Files/2013/Concussions/concussions-RB.pdf

13. Guskiewicz K, Register-Mihalik J, McCrory P, et al. Evidence-based approach to revising the SCAT2: introducing the SCAT3. Br J Sports Med. 2013;47(5):289–93.

14. Benson BW, Meeuwisse WH, Rizos J. A prospective study of concussions among National Hockey League players during regular season games: the NHL-NHLPA Concussion Program. CMAJ 2011;183:905–11

APPENDIX 1

SCAT2 Symptom Evaluation List

	None	Mild		Moderate		Severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like you're in a fog	0	1	2	3	4	5	6
Don't feel right	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional than usual	0	1	2	3	4	5	6
Irritable	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6

APPENDIX 2

Table of Statistically Non-Significant SCAT2 Pre-Post Scores Differences

Symptom	Mean Difference (post – pre score)	Standard Error of Mean Difference	95% Confidence Interval		p-value (2-tailed)
			Lower	Upper	
Neck pain	-0.538	0.320	-1.197	0.120	.105
Nausea or vomitting	-0.308	0.173	-0.665	0.049	.088
Dizziness	-0.500	0.243	-1.001	0.001	.051
Blurred vision	-0.269	0.197	-0.674	0.136	.183
Sensitivity to light	-0.269	0.239	-0.761	0.223	.271
Feeling slowed down	-0.308	0.247	-0.816	0.200	.224
Difficulty remembering	-0.462	0.310	-1.100	0.177	.149
Confusion	-0.462	0.237	-0.949	0.026	.063
Drowsiness	-0.462	0.243	-0.963	0.039	.069
Trouble falling asleep	-0.385	0.222	-0.843	0.073	.096
More emotional	-0.308	0.222	-0.761	0.146	.175
Nervous or anxious	-0.423	0.243	-0.923	0.077	.094