JAOA ORIGINAL CONTRIBUTION

Precompetition Manipulative Treatment and Performance Among Virginia Tech Athletes During 2 Consecutive Football Seasons: A Preliminary, Retrospective Report

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Context: One of the goals of providing manipulative treatment such as osteopathic manipulative treatment (OMT) is to restore maximal, pain-free movement of the musculoskeletal system and to enhance neuromuscular function. Anecdotally, some athletes have reported that their athletic performance improves after manipulative treatment.

Objective: To develop preliminary data to gain more understanding about the association between precompetition manipulative treatments provided to Division I football players and their athletic performance during each game for 2 consecutive football seasons.

Methods: The study design was a retrospective cohort study. Participants were football athletes at Virginia Polytechnic Institute and State University (Virginia Tech). Board-certified osteopathic physicians who were trained in osteopathic manipulative medicine and sports medicine performed OMT and determined the type of OMT techniques used and the spinal segments treated. One chiropractor provided chiropractic manipulative therapy. Prior to each game, the athletes who elected to receive precompetition manipulative treatment (ie, OMT or chiropractic manipulative therapy) underwent a focused physical examination and received manipulative treatment on the basis of clinical findings. After each game, the coaching staff "graded" the players by using a standard coaching algorithm. Offensive players received a percentile score (0 to 100) and defensive players received a numeric score (>30 was considered "very good").

Results: A total of 1976 manipulative treatments were provided to 115 football players in 2 consecutive football seasons. Sixty-two offensive players received 985 manipulative treatments, and 53 defensive players received 991 manipulative treatments. Treatments were applied to the affected regions of the spine: cervical, thoracic, lumbar, and sacral sections. Mean (standard deviation) performance scores were 67.8% (22.8%) and 11.1 (9.9) points among offensive and defensive players, respectively. The correlation coefficients between the numbers of the manipulative treatments and the performance scores were 0.107 (P=.407) among the offensive players and 0.218 (P=.117) among the defensive players.

Conclusion: Precompetition manipulative treatment was positively associated with improved performance among both offensive and defensive Virginia Tech football players. Although the associations between these 2 factors were relatively small and not statistically significant, we found positive correlations in performance of the offensive and defensive players.

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The goals of providing manual medicine are to restore maximal, pain-free movement of the musculoskeletal system, enhance neuromuscular function, and improve biomechanical balance. Precompetition manipulative treatment techniques are aimed at enhancing musculoskeletal function by warming the soft tissues and periarticular structures and "optimizing" joint function. Our experience with football players at Virginia Polytechnic Institute and State University (Virginia Tech) suggests that a substantial portion of athletes request precompetition manipulative

treatment for both pain control of current injuries and for performance enhancement.

Evidence-based studies show benefit from the use of manipulation to treat patients with musculoskeletal injuries. Osteopathic manipulative treatment (OMT), for example, has been shown to reduce back pain.[1,2] Evidence also shows that manual medicine techniques can have an effect on various kinematic parameters of spinal functioning that could be beneficial to athletes' health and performance.[3] Another study[4] showed the effect of chiropractic high-velocity, low-amplitude (HVLA) therapy on improving hip joint extension in healthy male junior athletes with a diagnosis of hip extension restriction (via the Thomas test). Chiropractic therapy also improved performance in various tests of agility, power, speed, and reaction time.[5] Although there are similarities between OMT and chiropractic manipulative therapy techniques, osteopathic physicians generally incorporate the soft tissues surrounding and supporting the spine or joint for manipulative treatments, whereas chiropractors typically focus more on the osteoarticular structures.[3]

Manipulative treatment has been provided as standard of care to athletes at the Olympic Games and other major international multisport games.[6] Precompetition manipulation may help enhance musculoskeletal function by warming up soft tissues to optimize joint function.[6] Results from a preliminary clinical trial[6] showed that spinal manipulative therapy (SMT) helped enhance paraspinal muscle functioning measured by surface electromyography. A pilot trial[7] investigating the effect of SMT on golfers found that golfers who were randomly assigned to receive a stretching program and SMT significantly improved their full-swing performance compared with golfers who received only a stretching program. In one study, manipulation of the cervical spine was shown to have an effect on brain function.[8] Pollard and Ward[9,10] suggested that upper cervical manipulation but not sacroiliac manipulation helped improve hip flexion range of motion. Patients with low back pain for 3 weeks to 6 months who were randomly assigned to receive osteopathic spinal manipulation required less medication compared with patients who received standard medical treatment.[11] A systematic review[1] of 8 studies evaluating effectiveness of OMT on low back pain compared with control treatment showed that the OMT helped to reduce the complaint of low back pain, and this finding was statistically significant. In another study,[12] muscle energy technique was shown to improve overall regional cervical range of motion on lateral bending and rotation planes. The results from these studies could provide some explanation for the potential benefit of precompetition manipulative treatment for athletes.[6]

Although there is a long history of the use of manipulative medicine in athletes, there is a limited number of publications that demonstrate it actually enhances performance. The objective of the present study was to develop preliminary data to gain more understanding about the association between the manipulative treatment provided to Division I football players before each game and their athletic performance during each game of 2 consecutive football seasons at Virginia Tech. We present findings describing the association between manipulation and athletes' performance on the basis of precompetition manual medicine and postcompetition standardized evaluation of player performance.

Methods

The present retrospective cohort study was approved by the Edward Via College of Osteopathic Medicine Institutional Review Board. Data collection occurred during 2 consecutive football seasons. Board-certified osteopathic physicians (including investigators P.G.B. and M.R., as well as Thomas A. Goodwin, DO; Gregory C. Beato, DO; and others) who are trained in osteopathic manipulative medicine and sports medicine performed the OMT before home games. The team chiropractor (G.T.) also provided precompetition manipulative treatment before home games. For the home games, typically 3 providers performed manipulative treatment. For the away games, P.G.B. performed all of the OMT. We would then estimate that approximately 75% of all of the manipulative treatment provided was performed by P.G.B., with the remainder being divided among the other practitioners.

Virginia Tech football players who competed during the 2 consecutive football seasons were eligible to participate in the study. The players self-selected for participation in the precompetition manipulative treatment provided by the sports medicine clinical staff.

The manipulative treatments were provided to the cervical, thoracic, lumbar, and sacral sections of the football players' spines. The type of treatment and spinal segments treated were determined by the practitioner's clinical evaluation. In general, the primary techniques used included soft tissue; muscle energy; low-velocity, high-amplitude; and HVLA.[13] Each treatment session took approximately 5 to 10 minutes. Prior to each game during the 2 consecutive seasons, the participating athletes underwent a focused physical examination and were treated with manipulative medicine as needed on the basis of clinical findings. The demonstration of the precompetition OMT on cervical, thoracic, lumbar, and sacral parts of the Virginia Tech players' spines is shown in *Figure 1*, and the manipulative treatment recording sheet is shown in the *Appendix*. The manipulative therapy provided by the chiropractor was similar to that provided by the osteopathic physicians.

After each game, the coaching staff graded the per-

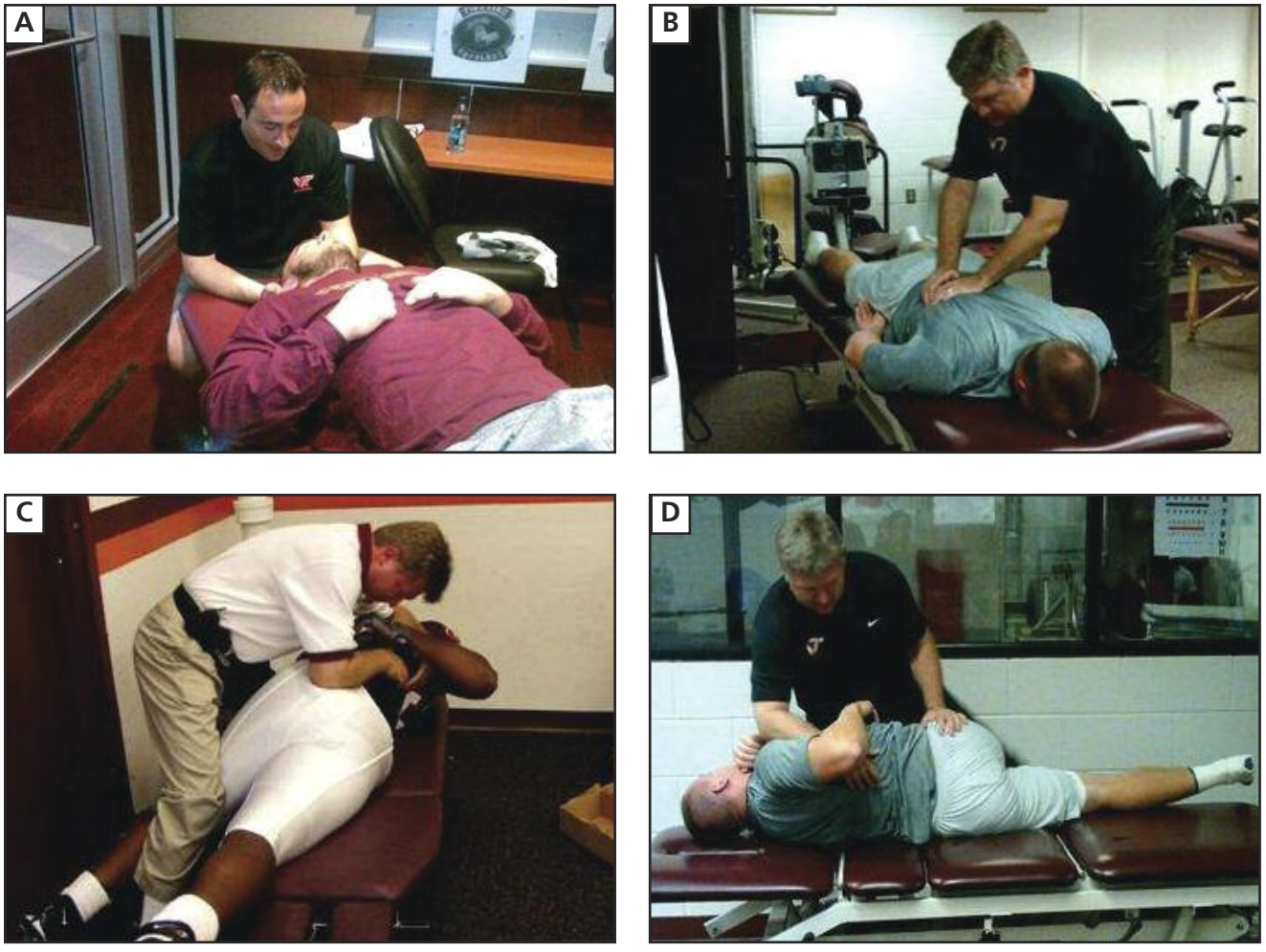

Figure 1. *Precompetition osteopathic manipulative treatment on the cervical (A), thoracic (B), and lumbar and sacral (C and D) sections of Virginia Tech football players' spines.*

formance of offensive and defensive players. The Virginia Tech coaching staff reviewed post-game film and evaluated each player's performance in every game by using a standard algorithm. Evaluations involved grading a participant according to specific performance criteria in the form of a percentile score for offensive players or points for defensive players. The coaches were blinded to which players received OMT. Overall grades were determined for each player for each game. Offensive players received a percentile score on a scale of 0 to 100, with 100 being the best score. Defensive players received a numeric score with no minimum or maximum score. A score greater than 30 was considered "very good." In general, points are awarded for good plays or decisions and deducted for poor plays or decisions. A relatively low number of points would translate into an overall poor in-game performance, while a relatively high number of points would translate into an overall good in-game performance. Although a total negative score is rare, it is possible.

Statistical Analysis

We used SAS version 9.2 statistical software (SAS Institute Inc, Cary, North Carolina) to perform the statistical analyses. Pearson correlation coefficients were calculated to evaluate the associations between the athletes' performances and numbers of manipulative treatments provided prior to each game separately for offensive and defensive players.

Results

The total number of participating football players was 115. Of the 115 participating players, 70 players (60.9%) played in both seasons, 19 players (16.5%) played only in season 1, and 26 players (22.6%) played only in season 2. Among the 70 players who played in both seasons, 33 (47.1%)

were offensive players and 37 (52.9%) were defensive players. Among the 19 players who played only in season 1, 12 were offensive players and 7 were defensive players. Among the 26 players who played only in season 2, 17 were offensive players and 9 were defensive players. The distribution of the number of participating Virginia Tech football players in the study is shown in *Figure 2*.

Sixteen players (13.9%) received manipulative treatment on the cervical, lumbar, thoracic, and sacral sections of their spines every game. Of those 16 players, 11 players played in both seasons (7 defensive and 4 offensive players), 4 players played only in season 1 (3 defensive and 1 offensive players), and 1 offensive player played only in season 2.

A total of 1976 manipulative treatments were provided to Virginia Tech football players prior to each game. Sixty-two offensive players received 985 manipulative treatments, and 53 defensive players received 991 manipulative treatments. The treatment was given to the affected regions of the spine, which was divided into cervical, thoracic, lumbar, and sacral sections. The study flowchart depicted in *Figure 3* explains the number of manipulative treatments provided to the players. The distributions of the number of the precompetition manipulative treatments provided to the players on each location of the spine for both seasons are shown in *Table 1* and *Figure 4*.

Performance ratings of the football players were separated by offensive players and defensive players. The mean (standard deviation) performance scores for offensive players were 67.8% (22.8%) and for defensive players were 11.1 points (9.9). Among the offensive football players, the correlation coefficient between the numbers of manipulative treatments and the performance was 0.107 (95% confidence interval [CI], -0.147 to 0.347; P=.407). Among the defensive football players, the correlation coefficient between the numbers of the manipulative treatments and the performance was 0.218 (95% CI, -0.058 to 0.460; P=.117). The descriptive statistics of the athletes' performance for offensive and for defensive players for each year is shown in *Table 2*. Scatter plots and Pearson correlation coefficients of the athletes' performances and number of manipulative tratments are shown in *Figure 5* for offensive and for defensive players.

Comment

We found a positive correlation between the number of precompetition manipulative treatments a player received during the season and his athletic performance. This positive correlation between manipulation and performance was noted over 2 competitive seasons. Although the association between the number of manipulative treatments and the performance enhancement was relatively small and not statistically significant, we did note positive correlations in performance of both the offensive and defensive players.

Further investigation is necessary to confirm these

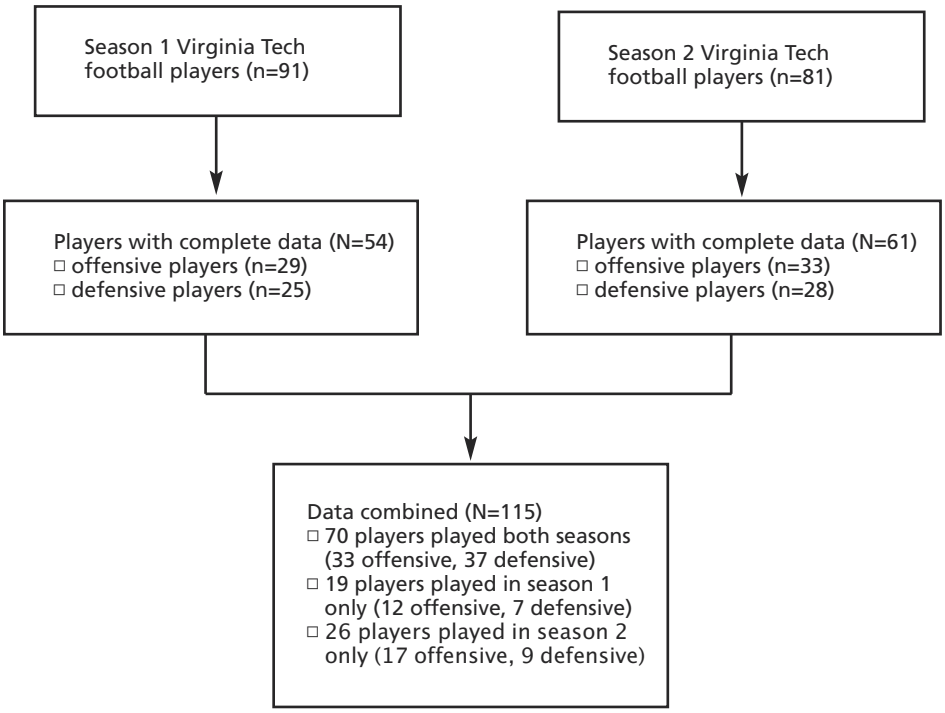

Figure 2. *Flowchart of participating football players from Virginia Tech in 2 consecutive seasons.*

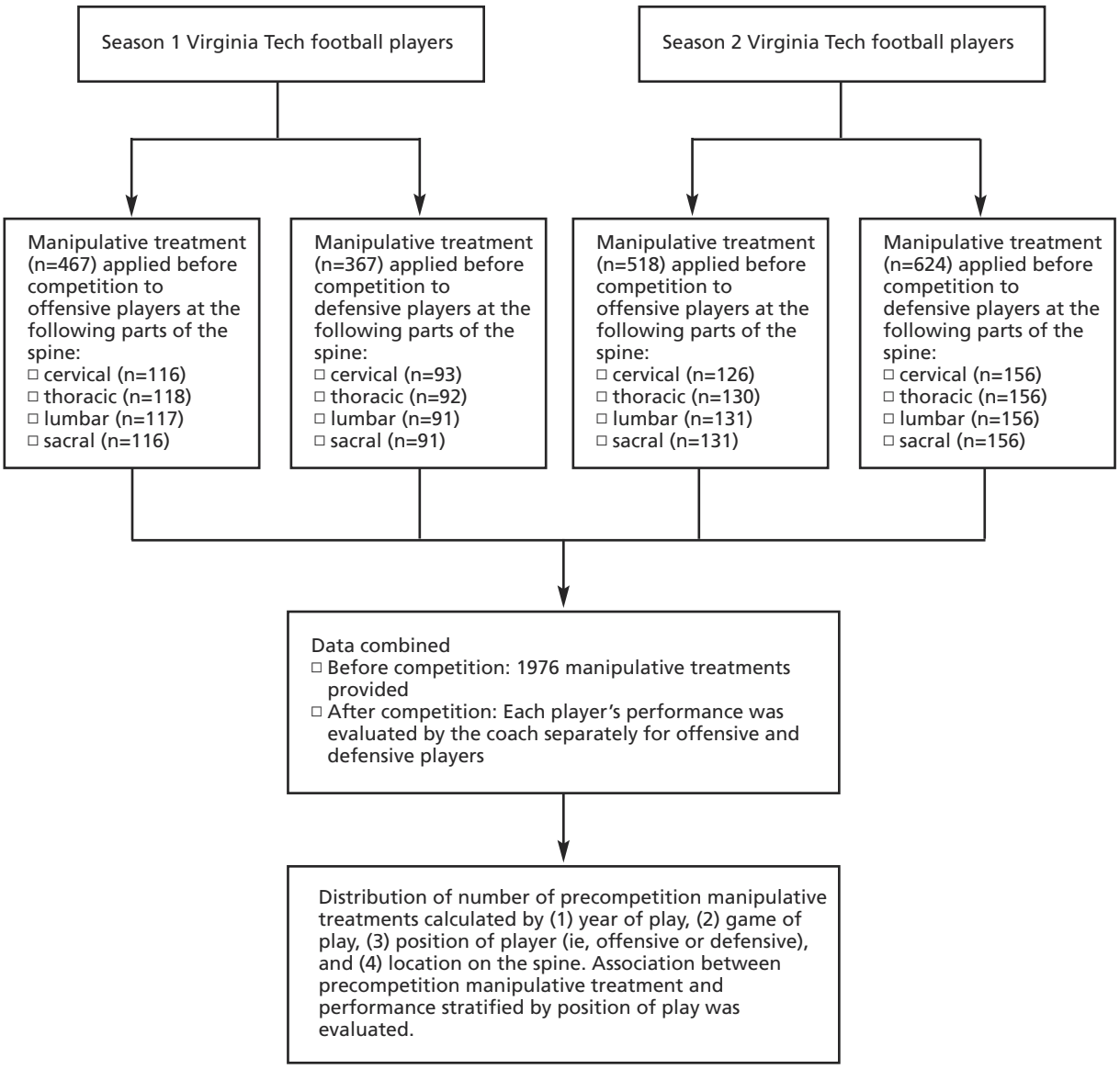

Figure 3. *Flowchart of manipulative treatment and performance evaluation of Virginia Tech football players in 2 consecutive seasons.*

findings. Although we recognize that the improvement was not statistically significant, small improvements in on-field performance may be athletically relevant and influence game outcomes. For sports medicine clinicians and athletes, manipulative treatments may potentially represent a novel, safe, and drug-free ergogenic aid.

The primary strength of this retrospective cohort study is that it is the first study to our knowledge to evaluate the effect of manipulative treatment, primarily OMT, on athletic performance in a real-world setting. Other work in this area has focused primarily on identifying the effect of manipulative treatment on specific components of musculoskeletal functioning as a proxy for athletic performance enhancement. The coaching staff grading was blinded in that the coaches had no knowledge of whether the athlete received manipulation. No medical providers were involved in grading the players' performance.

The primary weakness of the present study is that there are a number of other parameters that can affect athletic performance on a given day. Because this was a field study, it was virtually impossible to control for all of those potential confounders. One must also consider the possi-

Table 1.
No. of Precompetition Manipulative Treatments Provided to Athletes on Each Section of the Spine During 2 Consecutive Football Seasons

	Offensive Players					Defensive Players				
Opponent	Cervical	Thoracic	Lumbar	Sacral	Total	Cervical	Thoracic	Lumbar	Sacral	Total
Season 1										
Opponent 1	11	12	12	12	47	9	9	9	9	36
Opponent 2	9	9	9	8	35	7	7	7	7	28
Opponent 3	10	10	10	10	40	7	7	6	6	26
Opponent 4	7	7	7	7	28	7	7	7	7	28
Opponent 5	10	11	11	11	43	8	8	8	8	32
Opponent 6	11	11	11	11	44	9	9	9	9	36
Opponent 7	11	11	11	11	44	9	8	8	8	33
Opponent 8	12	12	12	12	48	9	9	9	9	36
Opponent 9	11	11	10	10	42	9	9	9	9	36
Opponent 10	10	10	10	10	40	9	9	9	9	36
Opponent 11	14	14	14	14	56	10	10	10	10	40
Total	**116**	**118**	**117**	**116**	**467**	**93**	**92**	**91**	**91**	**367**
Season 2										
Opponent 1	8	9	9	9	35	12	12	12	12	48
Opponent 2	12	12	12	12	48	13	13	13	13	52
Opponent 3	11	12	12	12	47	12	12	12	12	48
Opponent 4	13	14	15	15	57	15	15	15	15	60
Opponent 5	11	11	11	11	44	12	12	12	12	48
Opponent 6	13	13	13	13	52	15	15	15	15	60
Opponent 7	11	11	11	11	44	15	15	15	15	60
Opponent 8	15	15	15	15	60	18	18	18	18	72
Opponent 9	7	7	7	7	28	14	14	14	14	56
Opponent 10	13	14	14	14	55	17	17	17	17	68
Opponent 11	12	12	12	12	48	13	13	13	13	52
Total	**126**	**130**	**131**	**131**	**518**	**156**	**156**	**156**	**156**	**624**

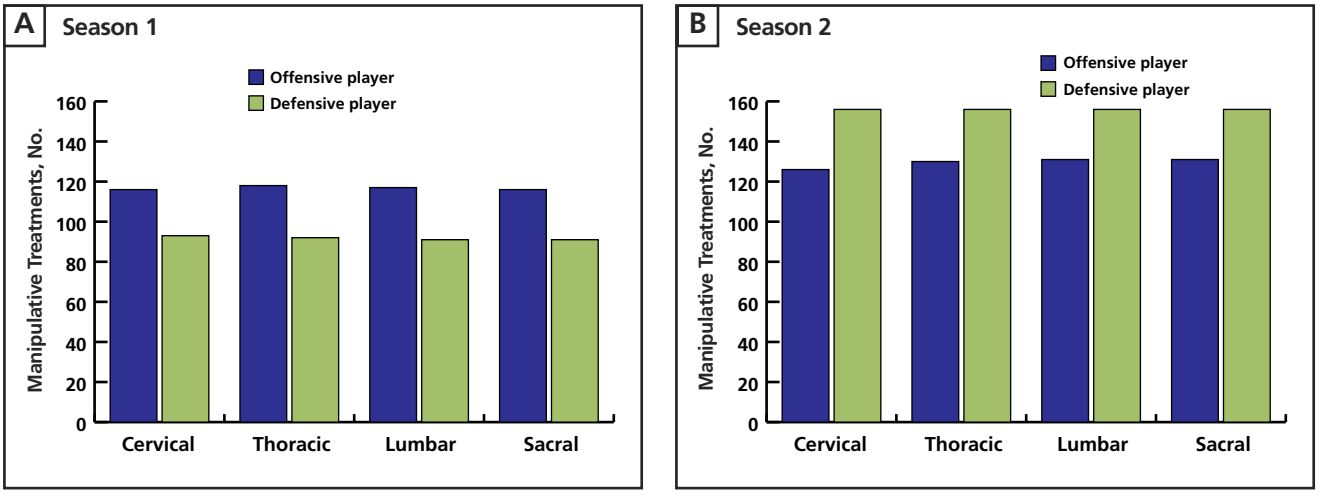

Figure 4. *Total number of precompetition manipulative treatments provided to football players on each section of the spine during season 1 (A) and season 2 (B).*

Table 2.
Performance Scores[a] of Virginia Tech Athletes During 2 Consecutive Football Seasons

	Offensive Players		Defensive Players	
Opponent	n[b]	%, Mean (SD)	n[b]	Mean (SD)
Season 1				
Opponent 1	25	80.8 (12.1)	25	8.1 (10.6)
Opponent 2	19	83.1 (8.9)	18	16.0 (13.4)
Opponent 3	22	84.8 (7.2)	16	23.4 (16.3)
Opponent 4	18	73.2 (26.8)	15	16.9 (11.2)
Opponent 5	20	79.7 (20.1)	16	14.1 (8.6)
Opponent 6	20	74.8 (21.5)	17	17.3 (14.4)
Opponent 7	21	75.0 (20.4)	15	15.8 (13.4)
Opponent 8	21	78.9 (27.4)	14	13.9 (10.8)
Opponent 9	18	76.8 (21.8)	14	16.9 (12.7)
Opponent 10	22	76.5 (20.9)	14	27.1 (14.1)
Opponent 11	21	71.5 (30.6)	13	16.5 (13.6)
Average Performance	**21**	**79.0 (10.5)**	**16**	**10.7 (11.2)**
Season 2				
Opponent 1	19	76.4 (21.3)	18	16.7 (15.0)
Opponent 2	31	80.6 (16.7)	26	9.0 (8.7)
Opponent 3	20	73.9 (26.4)	14	18.0 (15.7)
Opponent 4	21	77.9 (19.1)	16	25.6 (17.5)
Opponent 5	18	78.7 (20.2)	18	15.2 (10.8)
Opponent 6	29	83.5 (8.7)	29	11.5 (10.6)
Opponent 7	19	74.9 (27.0)	19	14.1 (9.4)
Opponent 8	21	74.6 (23.0)	18	14.9 (9.1)
Opponent 9	28	85.7 (9.0)	23	14.5 (8.6)
Opponent 10	30	84.0 (18.2)	24	17.5 (16.1)
Opponent 11	30	87.4 (18.9)	24	12.9 (10.7)
Average Performance	**24**	**82.8 (12.9)**	**21**	**10.6 (9.8)**

[a] Offensive players received a percentile score (0% to 100%), and defensive players received a numeric score (>30, very good).

[b] Number of players for each game.

bility of a placebo effect.[3] If the athlete believes that manipulative treatment will help him, then some benefit may occur.

Conclusion

The present study shows that precompetition manipulative treatment was positively associated with improved performance among both offensive and defensive Virginia Tech football players. The results from this study provide preliminary findings regarding the potential benefit of precompetition manipulative treatment on Division I football players' athletic performance.

Acknowledgments

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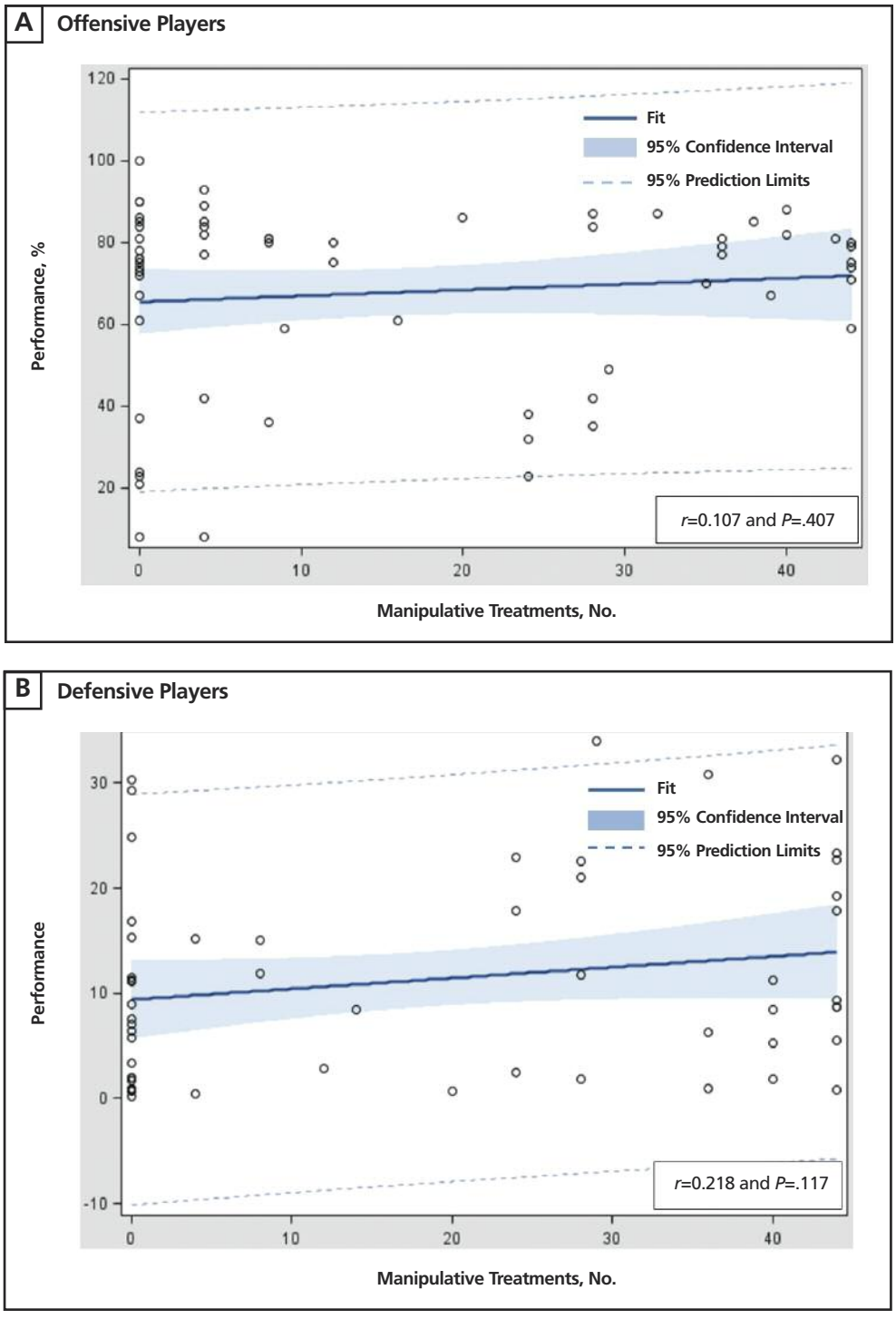

Figure 5. *Scatter plot of the number of manipulative treatments and athletes' performance for offensive (A) and defensive (B) football players and Pearson correlation coefficient.*

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Appendix

Manipulative treatment recording sheet used for Virginia Tech athletes during 2 consecutive football seasons.

Game Day Manipulation

Opponent ____________________ Date ____________________

Name	Manipulation				Comment
	Cervical	Thoracic	Lumbar	Sacral	
	C	T	L	S	
	C	T	L	S	
	C	T	L	S	
	C	T	L	S	
	C	T	L	S	
	C	T	L	S	
	C	T	L	S	
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