552 Journal of Manipulative and Physiological Therapeutics
Volume 24 • Number 9 • November/December 2001
0161-4754/2001/$35.00 + 0 **76/1/118979** © 2001 JMPT

Active Range of Motion in the Cervical Spine Increases After Spinal Manipulation (Toggle Recoil)

Wayne Whittingham, DC, PhD,[a] and Niels Nilsson, DC, MD, PhD[b]

ABSTRACT

Background: It has generally been assumed that spinal manipulation has the biomechanical effect of increasing spinal range of motion. Past research has shown that there are likely no lasting changes to passive range of motion, and it is unclear whether there is an increase in active range of motion after manipulation.

Objective: To study changes in active cervical range of motion after spinal manipulation of the cervical spine.

Design: A double-blind randomized controlled trial at the outpatient clinic Phillip Chiropractic Research Centre, RMIT University, Melbourne, Australia.

Methods: One hundred five patients with cervicogenic headache were randomized into 2 groups. After a baseline observation period, Group 2 received manipulation (toggle recoil) to the cervical spine, whereas Group 1 received sham manipulation. In the next trial phase, Group 1 received manipulation, whereas Group 2 received no treatment. This was followed by the final trial phase, in which Group 2 received sham manipulation and Group 1 received no treatment. After each trial phase, active range of cervical motion was measured with a strap-on head goniometer by 2 blinded examiners.

Results: After receiving spinal manipulation, active range of motion in the cervical spine increased significantly ($P < .0006$) in Group 2 compared with Group 1, and this difference between the treatment groups disappeared after the third trial phase in which Group 1 also received manipulation, as expected.

Conclusion: Spinal manipulation of the cervical spine increases active range of motion. (J Manipulative Physiol Ther 2001;24:552-5)

Key Indexing Terms: Spine; Range of Motion; Chiropractic; Osteopathy

INTRODUCTION

With increasing evidence that spinal manipulation may have an effect on some disorders[1-3] and not on others,[4,5] it becomes important to try to elucidate the biomechanical/physiologic basis for such experimental observations. It is generally assumed among practitioners that spinal manipulation affects the biomechanical behavior of the spine in some way. Most common is the assumption that spinal manipulation results in an increase in either passive or active range of motion.[6,7]

Changes of passive range of spinal motion after spinal manipulation have been studied under randomized, controlled, and blinded conditions,[8] and it seems relatively certain that there are no lasting changes in passive range of motion after manipulation, although it is possible that there may be a short-term increase in passive range of motion immediately after manipulation.[9,10]

Several uncontrolled studies have suggested that active range of motion increases after manipulation,[11-14] but the only blinded controlled study[15] failed to demonstrate an increase of active range of motion after spinal manipulation. However, that study compared an active control group (mobilization) with a manipulation group, and the results are therefore difficult to interpret.

This study aims to investigate changes in active range of motion as a result of spinal manipulation (toggle recoil) under double-blinded, randomized, controlled conditions.

METHODS

Through media advertisements, 105 patients with cervicogenic headache[16] were identified, gave their informed consent, and fulfilled the following inclusion criteria:

- Four or more days of headache a month for more than 6 months
- Headache located in the occipital region, with or without forward projection
- Headache provoked by neck movements or positions, or suboccipital manual pressure

[a]Plymouth Chiropractic Clinic, Plymouth, UK.
[b]Department of Sports Science and Clinical Biomechanics, University of Southern Denmark, Odense, Denmark.

This study was part of a PhD project at the School of Chiropractic and Osteopathy, Royal Melbourne Institute of Technology, Melbourne, Australia.

This study was funded by the Australian Spinal Research Foundation, the Chiropractic Centennial Foundation, and the Royal Melbourne Institute of Technology Alumni Fund.

Submit reprint requests to: Niels Nilsson, Department of Sports Science and Clinical Biomechanics, University of Southern Denmark, Campusvej 55, 5230, Odense M, Denmark.

Paper submitted September 11, 2000; in revised form October 10, 2000.
doi:10.1067/mmt.2001.118979

Table 1. Mean ± SEM for active range of motion in the cervical spine in the 12 weeks of the trial

	Week 0	Week 3	Week 6	Week 9	Week 12
Group 2					
N	55	55	56	54	53
Right rotation	57° ± 1.5°	57° ± 1.4°	67° ± 1.2°	69° ± 1.1°	70° ± 1.1°
Left rotation	54° ± 1.6°	55° ± 1.4°	67° ± 1.2°	68° ± 1.1°	69° ± 1.1°
Right lateral flexion	38° ± 1.4°	37° ± 1.2°	46° ± 1.1°	46° ± 1.2°	47° ± 1.1°
Left lateral flexion	36° ± 1.2°	36° ± 1.4°	44° ± 1.2°	44° ± 1.2°	45° ± 1.1°
Group 1					
N	49	50	49	49	49
Right rotation	56° ± 1.4°	56° ± 1.6°	57° ± 1.4°	73° ± 1.6°	73° ± 1.3°
Left rotation	54° ± 1.6°	54° ± 1.6°	56° ± 1.4°	71° ± 1.6°	72° ± 1.6°
Right lateral flexion	39° ± 1.1°	39° ± 1.3°	39° ± 1.1°	48° ± 1.3°	40° ± 1.4°
Left lateral flexion	38° ± 1.3°	38° ± 1.1°	39° ± 1.3°	47° ± 1.4°	47° ± 1.3°

- Objectively decreased upper cervical range of motion by goniometer or functional radiography
- Associated ipsilateral neck, shoulder or arm pain
- History of head and/or neck trauma.

The subjects were randomized into 2 treatment groups. Group 1 consisted of 29 women and 20 men with a mean age of 39.4 years (SD = 11.6), whereas Group 2 consisted of 34 women and 22 men with a mean age of 41.9 years (SD = 12.5). Randomization was done by the blinded drawing of patients' names from box. After registering entry data (week 0) the trial was conducted over 12 weeks as follows:

- Trial phase 1: A 3-week period of baseline observation for both groups.
- Trial phase 2: A 3-week period in which Group 2 received spinal manipulation to the upper cervical spine 3 times per week, and Group 1 received sham manipulation 3 times per week.
- Trial phase 3: A 3-week period in which Group 2 received no treatment and Group 1 received spinal manipulation to the cervical spine 3 times per week.
- Trial phase 4: The final 3-week period in which Group 2 received sham manipulation 3 times per week and Group 1 received no treatment.

In weeks 0, 3, 6, 9 and 12, active cervical range of motion was measured by 2 blinded examiners who had demonstrated excellent interexaminer reliability for these measurements in pretrial testing (Pearson r = 0.90-0.98).[17] Active range of motion was measured with a strap-on head goniometer consisting of an inclinometer dial for measuring lateral flexion and a compass dial for measuring rotation (Rangiometer, Maker, Inc). Right and left rotation and right and left lateral flexion were measured with the subjects sitting upright in an ergonomic receptionist's chair, their feet flat on the floor and arms at their sides. Subjects were instructed to carry any of the movements as far as they could without pain until all muscle stretching had seized. The blinded examiners ensured that the subjects performed the movements in the proper planes of motion. Subjects were blinded by being unaware of the changes expected and by the use of sham manipulations in 1 of the 3-week periods.

The manipulative technique used in this study was a single toggle-recoil thrust (a short-lever, high-velocity technique),[18] and the sham manipulation was delivered with a deactivated Pettibon (Spinal Technologies, Gig Harbor, Wash) instrument. All treatments were administered by the same chiropractor (WW), and indications for manipulation were fixations identified by motion palpation or radiographic examination (flexion-extension studies).

All statistical comparisons were 2-tailed by using the F distribution (variance-ratio test) for data from weeks 3, 6, and 12.

This study was approved by the RMIT University Ethics Committee.

RESULTS

Two patients in Group 2 dropped out during the trial as a result of moving from the area and increased work pressure, respectively. One patient in Group 1 dropped out for unknown reasons and could not be traced.

As illustrated in Figures 1 through 4, active range of motion increased significantly during the spinal manipulation periods. For all graphs, baseline cervical range of motion did not differ significantly between the groups (P = .21-.95). After the manipulation period for Group 2, this group had significantly greater active range of motion in all directions ($P \leq$ .006), with a mean increase in range of motion of 8° to 12° in each of the 4 directions of movement. After the manipulation period for Group 1, the 2 groups were again similar (P = .12-.25) because active range of motion in Group 1 had now increased a similar number of degrees, and this increase lasted until the end of the trial in week 12. Actual degrees of active range of motion for the 2 groups are given in Table 1.

DISCUSSION

We found a consistent and statistically significant increase in active range of motion in the cervical spine after manipulation.

This is in contrast to the findings of the only other randomized, controlled trial of change of active range of motion after spinal manipulation.[15] However, that study compared changes in a spinal manipulation group with changes in a spinal mobilization group, and active range of motion increased in both study groups. Active range of motion seemed to increase more in the manipulation group than in the mobilization group, and the lack of statistically significant differences between the 2 groups after treatment may have been the result of a masking effect of the increased range of motion in the spinal mobilization group (ie, that

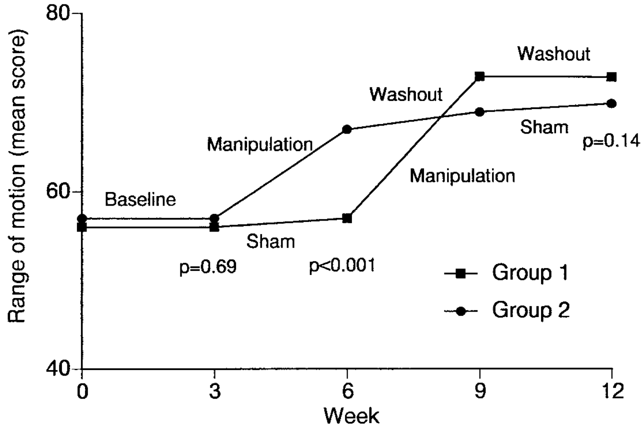

Fig 1. *Developments in mean active right rotation during the 12-week trial period.*

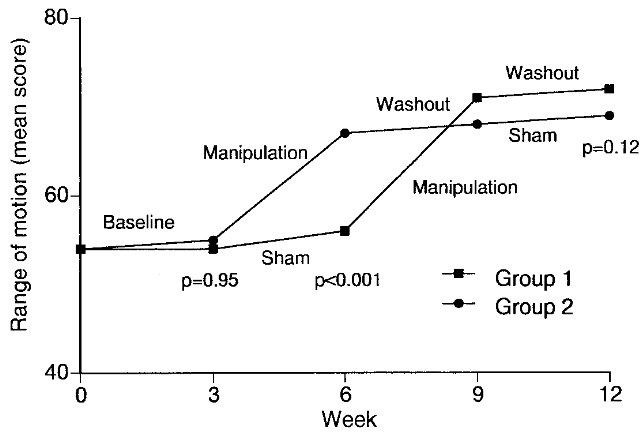

Fig 2. *Developments in mean active range of left rotation during the 12-week trial period.*

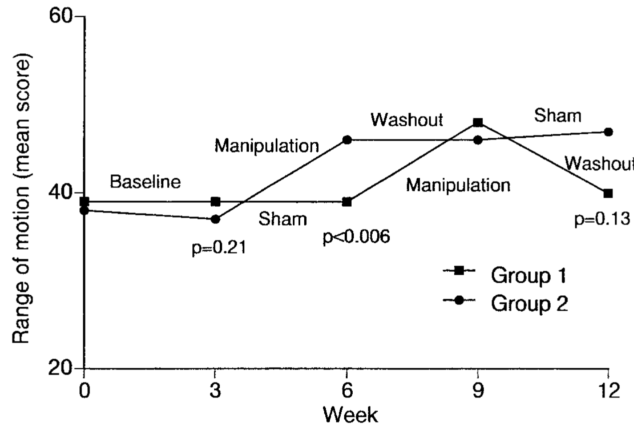

Fig 3. *Developments in mean active range of right lateral flexion during the 12-week trial period.*

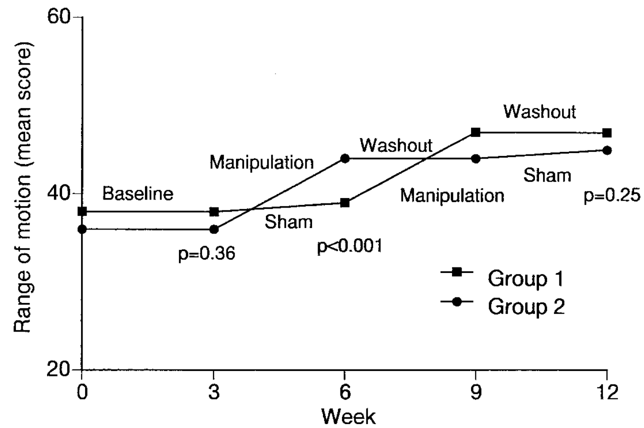

Fig 4. *Developments in mean active range of left lateral flexion during the 12-week trial period.*

study design was less than ideal because of an actively treated control group).

We have chosen not to include the movements of flexion and extension in this study. These movements in the cervical spine are gravity assisted at the end of their range, and because of the relatively large mass of the head, it has been argued that cervical flexion and extension are essentially passive movements at the end of their range.[19]

We used a cross-over design, which in its usual (pharmacologic) application requires the therapeutic intervention to be fully reversible within the time frame of the wash-out period because the same subject is "used" twice. However, in our use of this design, the subjects are not, in fact, "used" twice; the results should be interpreted as a standard controlled design in weeks 0 to 6, with a double check added in weeks 7 to 12, during which any significant differences would be expected to disappear. The use of the cross-over design in this manner solves the ethical dilemma of standard controlled designs, in which half of the subjects do not receive an effective treatment.

CONCLUSION

Although we attempted to blind the subjects by using a sham manipulation period, we cannot be absolutely certain that this part of the blinding was successful in all subjects. However, even if some subjects were able to differentiate between the sham manipulation and the real manipulation, they were still blinded to the expected treatment effect.

The blinding of the examiners was achieved without difficulty by keeping them ignorant of treatment group allocations.

REFERENCES

1. Andersson G, Lucente T, Davis A, Kappler R, Lipton J, Leurgans S. A comparison of osteopathic spinal manipulation with standard care for patients with low back pain. N Engl J Med 1999;341:1426-31.
2. Meade T, Dyer S, Browne W, Townsend J, Frank AO. Low back pain of mechanical origin: randomized comparison of chiropractic and hospital outpatient treatment. BMJ 1990; 300:1431-7.
3. Nilsson N, Christensen HW, Hartvigsen J. The effect of spinal manipulation in the treatment of cervicogenic headache. J Manipulative Physiol Ther 1997;20:326-30.
4. Bove G, Nilsson N. Spinal manipulation in the treatment of episodic tension-type headache: a randomized controlled trial. JAMA 1998;280:1576-9.
5. Balon J, Aker PD, Crowther ER, Danielson C, Cox PG, O'Shaughnessy D, et al. A comparison of active and simulated chiropractic manipulation as adjunctive treatment for childhood asthma. N Engl J Med 1998;339:1013-20.

6. Bergmann TF, Peterson DH, Lawrence DJ. Chiropractic technique. New York: Churchill Livingstone; 1993.
7. Schafer RC, Faye LJ. Motion palpation and chiropractic technic. 2nd ed. Huntington Beach (CA): Motion Palpation Institute; 1990.
8. Nilsson N, Wulff Christensen H, Hartvigsen J. Lasting changes in passive cervical range of motion following spinal manipulation—a randomized blinded controlled trial. J Manipulative Physiol Ther 1996;19:165-8.
9. Nansel DD, Cremata E, Carlson J, Szlazak M. Effect of unilateral spinal adjustments on goniometrically-assessed cervical lateral-flexion end-range asymmetries in otherwise asymptomatic subjects. J Manipulative Physiol Ther 1989;12:419-27.
10. Brodin H. Cervical pain and mobilization. Manual Med 1985; 7:18-22.
11. Cassidy JD, Quon JA, LaFrance LJ, Yong HK. The effect of manipulation on pain and range of motion in the cervical spine: a pilot study. J Manipulative Physiol Ther 1992;15:495-500.
12. Hviid H. The influence of chiropractic treatment on the rotary mobility of the cervical spine. Ann Swiss Chiropr Assoc 1971; 5:31-44.
13. Hviid H. Functional radiography of the cervical spine. Ann Swiss Chiropr Assoc 1963;3:37-65.
14. Yeomans SG. The assessment of cervical intersegmental mobility before and after spinal manipulative therapy. J Manipulative Physiol Ther 1992;15:106-14.
15. Cassidy JD, Lopes AA, Yong HK. The immediate effect of manipulation versus mobilization on pain and range of motion in the cervical spine: a randomized controlled trial. J Manipulative Physiol Ther 1992;15:570-5.
16. Olesen J. Classification and diagnostic criteria for headache disorders, cranial neuralgias, and facial pain. Cephalalgia 1988; 8(Suppl 7):1-96.
17. Whittingham W. The efficacy of cervical adjustments (Toggle recoil) for chronic cervicogenic headaches [thesis]. Melbourne, Australia: Royal Melbourne Institute of Technology; 1999.
18. Byfield D. Chiropractic manipulative skills: fundamentals of clinical practice. 1st ed. Toronto: Butterworth-Heinemann; 1996.
19. Nilsson N, Hartvigsen J, Christensen HW. Normal ranges of passive cervical motion for women and men 20-60 year old. J Manipulative Physiol Ther 1996;19:306-9.