THE BENEFITS OUTWEIGH THE RISKS FOR PATIENTS UNDERGOING CHIROPRACTIC CARE FOR NECK PAIN: A PROSPECTIVE, MULTICENTER, COHORT STUDY

Sidney M. Rubinstein, DC, MSc,[a] Charlotte Leboeuf-Yde, DC, MPH, PhD,[b] Dirk L. Knol, PhD,[c] Tammy E. de Koekkoek, DC,[d] Charles E. Pfeifle, DC,[e] and Maurits W. van Tulder, PhD[f,g]

ABSTRACT

Objective: This study describes both positive clinical outcomes and adverse events in patients treated for neck pain by a chiropractor.

Methods: This study was a prospective, multicenter, observational cohort study. Patients with neck pain of any duration who fulfilled the inclusion criteria were recruited in a practice-based study. Data were collected on the patients and from the chiropractors at baseline, the first 3 visits, and at 3 and 12 months. Clinical outcome measures included (1) neck pain in the 24 hours preceding the visit, (2) neck disability, (3) treatment satisfaction, (4) global assessment, and (5) adverse events. *Recovery* was defined as "completely improved" or "much better" using the global assessment scale. An *adverse event* was defined as either a new related complaint or a worsening of the presenting or existing complaint by >30% based upon an 11-point numerical rating scale.

Results: In all, 79 chiropractors participated, recruiting 529 subjects, representing 4891 treatment consultations. Follow-up was possible for 90% and 92%, respectively, at 3 and 12 months. Most patients had chronic, recurrent complaints; mild to moderate disability of the neck; and a mild amount of pain at baseline; and two thirds had sought previous care for the presenting complaint in the preceding 6 months. Adverse events following any of the first 3 treatments were reported by 56%, and 13% of the study population reported these events to be severe in intensity. The most common adverse events affected the musculoskeletal system or were pain related, whereas symptoms such as tiredness, dizziness, nausea, or ringing in the ears were uncommon (<8%). Only 5 subjects (1%) reported to be much worse at 12 months. No serious adverse events were recorded during the study period. Of the patients who returned for a fourth visit, approximately half reported to be recovered, whereas approximately two thirds of the cohort were recovered at 3 and 12 months.

Conclusion: Adverse events may be common, but are rarely severe in intensity. Most of the patients report recovery, particularly in the long term. Therefore, the benefits of chiropractic care for neck pain seem to outweigh the potential risks. (J Manipulative Physiol Ther 2007;30:408-418)

Key Indexing Terms: *Neck pain; Chiropractic; Manipulation, Spinal; Adverse effects; Cervical vertebrae*

[a] Research Fellow, Institute for Research in Extramural Medicine (EMGO-Institute), VU University Medical Center, 1081 BT Amsterdam, the Netherlands.

[b] Research Professor, The Back Research Center, Part of Clinical Locomotion Science, University of Southern Denmark, DK-5750 Ringe, Denmark.

[c] Statistician, Institute for Research in Extramural Medicine (EMGO-Institute), VU University Medical Center, 1081 BT Amsterdam, the Netherlands.

[d] Private practice, Soest, the Netherlands.

[e] Private practice, Oosterhout, the Netherlands.

[f] Professor of Health Technology Assessment, Institute for Research in Extramural Medicine (EMGO-Institute), VU University Medical Center, Amsterdam, the Netherlands.

[g] Professor, Department of Health Economics and Health Technology Assessment, Institute of Health Sciences, Faculty of Earth and Life Sciences, Amsterdam, the Netherlands.

Submit requests for reprints to: Sidney Rubinstein, DC, MSc, Research Fellow, Institute for Research in Extramural Medicine (EMGO-Institute), VU University Medical Center, Van der Boechorststraat 7, 1081 BT Amsterdam, the Netherlands (e-mail: *sm.rubinstein@vumc.nl*).

Paper submitted January 10, 2007; in revised from April 11, 2007; accepted 15 April 2007.

0161-4754/$32.00

doi:10.1016/j.jmpt.2007.04.013

Neck pain is a common and costly complaint in Western society.[1,2] Studies of manipulation for nonspecific neck pain have suggested that manipulation is an effective therapy, particularly when combined with exercise.[3,4] However, as with other interventions for the treatment of neck pain, such as nonsteroidal anti-inflammatory drug use,[5-7] cervical spine manipulation is not without adverse events. On the one hand, cases of stroke following cervical spine manipulation are rare but well-documented,[8-10] whereas on the other hand, much less is known about the much more common adverse, but benign, events.

Previous observational studies have shown that adverse events, such as increased pain or stiffness and, to a lesser degree, radiating symptoms and headache, following manipulative treatment to the neck and/or back are relatively common, mild in intensity, and self-limiting.[11-15] Only one previous study has specifically targeted cervical spine manipulation and examined the relationship of these adverse events to positive outcome measures. That study concluded that subjects with adverse events were less satisfied with care, perceived less improvement in their neck symptoms, and had more pain and disability at all follow-up measurements.[15] In contrast, studies of low back pain involving manipulation have identified certain adverse events as a positive predictor of outcomes.[16,17]

It must be noted here that various terms have been used in previous literature to describe adverse events following chiropractic treatments, such as *unpleasant reactions*, *side effects*, or *adverse reactions*. However, according to international clinical trial terminology, the established term for this phenomenon is *adverse events* and is the term that will be used further throughout this article. This has been further operationally defined in the "Methods" section.

The primary objective of this present report, therefore, is to describe both positive clinical outcomes and adverse events following the first 3 treatments in a large cohort presenting with neck pain to 79 chiropractors. A secondary objective is to describe the sociodemographic and clinical profile of these subjects.

Methods

Study Design and Source Population

A prospective, multicenter, practice-based cohort study was conducted for patients with neck pain. Subjects who fulfilled the inclusion criteria (defined below) were recruited by chiropractors in their private clinics throughout the Netherlands and were followed up after 3 and 12 months. Each participating chiropractor was asked to recruit 10 consecutive new patients.

Recruitment of Chiropractors and Subjects

Chiropractor Inclusion Criteria and Recruitment. All 189 chiropractors who were members in good standing of the Netherlands Chiropractors' Association were invited to participate. Participants were required to carry out the examination and treatment personally. Chiropractors undergoing their internship were excluded. Recruitment was pursued by means of a flyer mailed to all members of the Netherlands Chiropractors' Association, by personal invitation, and through a presentation at a national chiropractic association meeting.

Patient Inclusion and Exclusion Criteria. All new patients between the ages of 18 and 65 years with neck pain of any duration who had not undergone chiropractic care or manual therapy in the prior 3 months were eligible for recruitment. In this report, neck pain includes those with neck and neck-related pain, that is, cervicothoracic and/or periscapular pain. Although inclusion was based upon a primary complaint of neck pain, patients who also had pain in other areas were not excluded. Patients were required to have a basic understanding of the Dutch language and be able to independently complete the series of questionnaires. Subjects were recruited between September 1, 2004, and April 15, 2005.

Subjects were excluded if they had a red flag (eg, suspected infection, fracture, tumor, metastasis, or intravenous drug use) or any other condition thought to be a contraindication for cervical spine manipulation (eg, luxation or instability of the vertebral articulations). This was left to the judgment of the chiropractor.

In order to check for possible recruitment bias during the inclusion phase, a sample was taken in 5 practices in which the number of subjects recruited to the study was cross-checked with the actual number of eligible patients during the recruitment period. The total number of new patients seen in these practices during this period was also recorded. Selection of these practices was based upon geographic proximity to the research center.

Study Protocol. Prior to the start of data collection, a number of training sessions were conducted with the chiropractors throughout the country in order to present the study methods, increase consistency among chiropractors in applying these, and limit problems associated with patient recruitment. Both the chiropractor and his/her assistant(s) were asked to attend.

Data Collection and Clinical Outcome Variables

Procedure. Data were collected from patients within individual practices by means of a self-administered questionnaire at baseline and prior to treatment at the second and fourth visits. In order to increase the response rate, patients were also provided with an envelope in which to place their completed questionnaires. All forms were precoded in order to ensure anonymity. Additional follow-ups were conducted from a central data collection center at the university at 3 and 12 months using postal questionnaires. If the participant failed to respond to a written reminder at 12 months, a shortened structured telephone interview was conducted. This interview consisted of 5 questions regarding pain, perceived recovery, and treatment

satisfaction. The clinical outcome measures used throughout the study were pain and disability,[18-20] perceived recovery,[21-23] treatment satisfaction,[15,24] and adverse events (or concomitant symptoms) following treatment.

Chiropractor

Chiropractors completed a questionnaire administered once at the beginning of the study relating to basic sociodemographic information concerning himself/herself and treatment practices (eg, years of experience, types of techniques and/or therapies commonly used).

Patient

Pain, Disability, and Recovery. At all points of data collection, an 11-point numerical rating scale (NRS) was used to assess pain in the 24 hours preceding the visit. Disability was also measured at these times using the Neck Disability Index (NDI); however, disability was not recorded at the second visit.[25,26] The NDI has been demonstrated to be a sensitive and valid instrument.[27] Perceived recovery was measured at all follow-up times and scored using a 6-point Likert scale, as follows: (1) "completely improved," (2) "much better," (3) "somewhat better," (4) "unchanged," (5) "somewhat worse," and (6) "much worse." Those subjects who were either "completely improved" or "much better" were considered to be "recovered."

Treatment Satisfaction. Satisfaction was measured at the fourth visit and at 3 and 12 months using a 10-item instrument[28] that was used in a prior study of adverse events to cervical spine manipulation.[15,24] Two other questions were also posed at these same time intervals: (1) "How satisfied are you with the treatment by your chiropractor?" (11-point NRS, ranging from "very dissatisfied" to "very satisfied") and (2) "Would you visit a chiropractor again with this or a similar complaint?" (yes/no).

Adverse Events. The following symptoms were assessed at every time interval, except items 1 and 2, which were not measured at baseline because they relate only to the previously administered treatment: (1) increased pain/stiffness at the treated area, (2) increased pain/stiffness in another treatment-related area, (3) headache, (4) tiredness/fatigue, (5) radiating pain in the arm or hand, (6) dizziness or lightheadedness, (7) nausea, (8) ringing in the ears, (9) confusion or disorientation, (10) depression or fear, and (11) any other not specified reaction. Adverse events were measured using a similar questionnaire as in the Scandinavian studies.[13,14,29] Intensity of adverse events was also graded using an 11-point NRS. At the second visit, patients were queried about any potential events following the first visit. In the data analysis, an adverse event reported at the second visit was defined as either (1) a new related complaint that was not present at baseline or (2) a worsening of the presenting complaint or an existing complaint by >30% compared with baseline. Thirty percent was chosen as a cutoff because it has been demonstrated that this represents a minimally clinically important difference on an 11-point NRS.[30] At the fourth visit, patients were queried about any events following the second or third visit. A similar definition was used to define adverse events at the fourth visit as the second visit; however, at the fourth visit, the comparison was made with the second visit, not baseline. *Intense* adverse events were defined as any adverse event fulfilling our definition of an adverse event and that also scored $\geq$8 in intensity on the 11-point NRS. This term must not be confused with *serious* adverse events, which refer to events resulting in death, life-threatening situations, the need for admittance to a hospital, or temporary or permanent disability.

The following were also assessed at baseline: age, sex, sociodemographics, and the nature and severity of the presenting complaint. Patients were also queried about previous chiropractic, manual therapy, and medical care for the same or similar complaints. Fear of, or apprehension concerning, the treatment and treatment expectation were also assessed using 11-point NRS scales. Health status was measured on a 100-point vertical scale, ranging from worst (0) to best (100) possible health; and fear of movement or reinjury was measured through the 17-item Tampa Scale for Kinesiophobia.[31]

Intervention

The treatment was left to the discretion of the chiropractor. The type of manipulative and/or mobilization technique used was recorded on standardized forms immediately following the first and third treatment, as well as the use of any adjunct therapy, the number of adjustments given, the area that was treated, whether the chiropractor considered that rotation was used, and whether multiple manipulative attempts were directed at a single segment.

Approval

The study was approved by the Institutional Review Board of the Vrije University Medical Centre, Amsterdam, the Netherlands. Informed consent was not required because this is an observational study.

Statistical Methods

Mean values and standard deviation (SD) were calculated for continuous variables. These variables were also examined for skewness and kurtosis; and where relevant, medians and interquartile ranges (IQRs) were presented instead of the mean. Frequency distributions were calculated for categorical variables. For reporting of many of the baseline variables, there were few missing values (<5% of cohort); therefore, in many cases, only a percentage is reported. Response-function imputation was used for missing data for the disability questionnaire, the Tampa Scale for Kinesiophobia, and the patient satisfaction scale when $\leq$50% of the data was missing, although this was only necessary for a small percentage of patients; and in most cases, $\leq$10% of the data was missing.[32] Imputation was performed separately

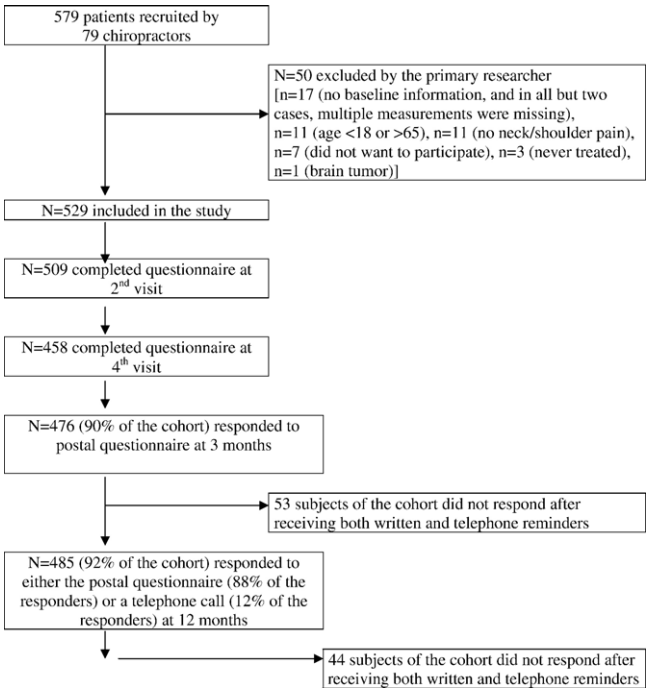

Fig 1. *Flowchart demonstrating recruitment and follow-up throughout the study period.*

for each of the aforementioned questionnaires and based the correlation between each variable with a missing value with the other responses in those questionnaires. All data were analyzed in SPSS version 12.0 (SPSS Inc, Chicago, Ill). Accuracy of the entered data was checked using a random sample of 25 patients. The baseline data entry form was used, which contained 94 variables. Two data entry mistakes were discovered, resulting in an error of 0.1%; and it was concluded that the data had been accurately entered.

Results

Participating Chiropractors

In total, 79 chiropractors (79 of 190; 42% of the available population) participated in the study. Reasons among the chiropractors for not participating included residing outside the country (n = 2), pregnancy leave (n = 3), retiring (n = 3), not interested (n = 4), and did not regularly perform manipulative techniques (n = 2). One chiropractor was excluded because of pending statutory problems. The remaining 96 did not respond to various requests. Three chiropractors who agreed to participate did not recruit any patients. Of those who did recruit subjects, each chiropractor recruited 7.6 ± 2.9 (mean ± SD) patients.

Study Population

During the 7-month recruitment period, 579 patients were recruited. Fifty subjects were excluded for various reasons (Fig 1), resulting in a cohort of 529 subjects. Ninety-six percent and 87% of the study population returned for a second and fourth visit, respectively, whereas 90% and 92% responded to the long-term follow-up at 3 and 12 months, respectively. Twelve percent of the 92% that responded at

Table 1. *Sociodemographic and clinical baseline characteristics for patients in the Netherlands chiropractic neck pain cohort study (n = 529)*

Sociodemographic variables	Percentage (%)
Sex, female	69.0
Age, y (mean, SD)	41.2 (11.5)
Highest level of education achieved	
Elementary school	4.8
High school	31.4
Technical school	55.0
University or postgraduate education	8.8
Employment status	
Full-time (>32 h/wk)	44.2
Part-time	33.3
Not working (including unemployed, housewives)	12.2
Sick leave or workers compensation	7.2
Retired	3.1
Clinical baseline variables	
Duration of the presenting complaint	
1 d-<4 wk	8.4
4-12 wk	16.8
>12 wk-1 y	23.2
>1 y	51.6
Self-assessed health trend regarding the presenting complaint	
Getting better	4.6
Getting worse	21.2
Staying the same	26.1
Rather varied	48.1
Previous episode with this complaint (% yes)	71.6
Radiating pain in an upper extremity (% yes)	52.0
Paresthesia and/or "dead" feeling in an upper extremity (% yes)	39.3
Morning pain related to the chief complaint (% yes)	70.1
Night pain related to the chief complaint (% yes)	36.9
Presently involved in judicial proceedings in regard to this complaint (% yes)	2.5
Medication use	
None	65.8
Over-the-counter pain medication	5.5
Prescription pain medication	6.2
Other prescription (nonpain) medication	21.9
Bruxism (% yes)	24.2
Who have you seen for this complaint? (% yes)[a]	
General practitioner	66.9
Specialist	18.9
Chiropractor or manual therapist	36.7
Physical therapist	25.5
Cesar/Mensendieck therapy (ie, postural and exercise therapy)	3.4
Acupuncturist	2.6
Other doctor or therapist than those mentioned above	10.4

[a] Multiple answers possible.

Table 2. *Concomitant symptoms reported at baseline and throughout the study period*

Type of other symptom and severity of the complaint[a]	Baseline (n = 529) (%)	2nd visit (n = 509) (%)	4th visit (n = 458) (%)	3 mo (n = 476) (%)	12 mo (n = 485) (%)
Tiredness or fatigue	77.3	22.0	14.0	66.0	66.1
Headache	75.4	26.2	16.0	71.8	71.5
Dizziness or light-headedness	60.0	18.1	10.6	48.9	53.5
Radiating pain	52.0	18.9	14.1	55.7	55.3
Nausea	34.8	11.8	5.7	21.4	21.0
Depression or fear	28.6	4.8	3.1	22.7	22.2
Confusion or disorientation	27.3	6.7	4.8	22.1	19.8
Ringing in the ears	23.0	9.9	7.1	29.8	29.5
Other symptoms	–	2.6	4.7	5.8	5.5
Median no. of symptoms per patient (IQR)	3 (2-5)	0 (0-2)	0 (0-0)	2 (1-5)	2 (0-4)

En dash (–) indicates unrecorded data.
[a] Responses are ordered according to prevalence at baseline from highest to lowest.

12 months were evaluated using the shortened telephone assessment instead of completing the written questionnaire. Potential response bias was assessed in order to compare responders to nonresponders. However, an analysis at 3 and 12 months showed no obvious differences between these 2 groups in the baseline variables (available upon request). A total of 4891 treatment consultations were registered during the 12-month period, and chiropractors delivered 9.3 ± 5.3 (mean ± SD; median, 8.0; range, 0-38) treatments per patient. Almost all patients (90%) returned for a second visit within 8 days of the first visit, and 90% returned for a fourth visit within 6 weeks of the first visit.

Baseline Characteristics for the Chiropractors

The participating chiropractors were 37.6 ± 9.4 years old (mean ± SD; range, 22-74) and had 10.2 ± 6.3 years of experience (mean ± SD; median, 9.5; range, 1-28 years). Most were male (65%), had received their chiropractic education at a European institution (66%), worked full-time (96%), and regularly used the following techniques (in hierarchal order, from more to less common): diversified manipulation (a high-velocity, low-amplitude manipulative technique commonly used by chiropractors), Activator (a hand-held, spring-loaded instrument designed to deliver a measured force), soft-tissue massage or trigger point therapy, and/or mobilization.

Baseline Characteristics for the Patients

Sociodemographic and clinical baseline characteristics are presented in Table 1. The recruited subjects were predominantly female, middle-aged, had a high school or technical school education, and were employed. Most of the patients had a chronic complaint that was intermittent in nature, had morning pain, had at least one prior episode related to the complaint, and were not currently using any medication. Two thirds had seen a general practitioner for the presenting complaint, and approximately one fifth had seen a specialist in the 6 months prior to a visit to the chiropractor. Approximately one third had undergone prior chiropractic care or manual therapy ever. The subjects had little fear of, or apprehension concerning, the treatment (median, 0; IQR, 0-2), expected the treatment to be effective (mean, 7.0; SD, 2.0), and were generally healthy (mean, 67.8; SD, 17.2), whereas most (87%) had mild to moderate disability. Only 7% had a high level of kinesiophobia (mean, 34.1; SD 6.2).[33]

Concomitant Symptoms at All Measurement Periods

At baseline, 94% of the patients had at least one concomitant symptom other than neck pain; and half of the cohort had 3 or more other symptoms (Table 2). Twenty-two percent rated at least one of these symptoms as severe in intensity (≥8 on the 11-point NRS scale). The most common symptoms were headache, tiredness, dizziness, or radiating pain, and less frequently, nausea or ringing in the ears. At the second and fourth visits, only 34% and 22%, respectively, of the cohort had concomitant symptoms. At 3 and 12 months, when most patients had likely discontinued care or had been discharged, the estimated prevalence of these concomitant symptoms approached the baseline values once again.

Treatment Techniques and Type of Care Delivered

The treatment techniques and other therapies used at the first and third visits are presented in Table 3. The principal techniques used at the first and third visits were diversified, soft-tissue or trigger point therapy, Activator, and mobilization. Most patients (85%) underwent an upper or lower cervical spine manipulation at both the first and third visits. In almost all subjects (97%), a manipulative technique (ie, diversified, Activator, Gonstead, or toggle-recoil) was used at any of the first 3 treatments; and occasionally, chiropractors used multiple manipulative attempts directed at the same segment.

Table 3. *Treatment techniques used, therapies performed, and other treatment parameters recorded at the first and third treatments*

Techniques, therapies, and other treatment parameters	1st visit (n = 529) (%)	3rd visit (n = 458) (%)
Technique used (% yes)[a,b]		
Diversified	78.3	76.7
Soft-tissue or Nimmo (trigger point therapy)	28.9	33.8
Activator	15.1	19.7
Traction	12.3	12.9
Gonstead	11.0	8.7
Mobilization	9.3	12.3
Sacrooccipital technique or cranial technique	4.7	5.3
Toggle	2.6	2.8
Other therapies used (% yes)[a,b]		
Exercise advice	35.7	24.8
Heat or ice	17.4	11.5
Other technique or therapy (eg, acupuncture, homeopathy, heel lifts, Thompson drop)	17.3	17.6
Dietary advice	5.3	2.1
Total no. of adjustments given in the neck		
None	15.2	9.6
1	25.2	20.3
2-3	49.6	60.2
>3	10.0	10.0
Treated area[b]		
Upper cervical spine (C0-C2)	49.9	48.8
Mid-lower cervical spine (C3-C7)	53.7	57.3
Upper thoracic spine (T1-4)	53.9	52.4
Mid-lower thoracic spine (T5-T12)	40.1	34.0
Lumbar spine	13.4	16.8
Pelvis/sacrum	23.4	18.9
Rotation was used during the treatment (% yes)	56.6	58.8
Multiple manipulative attempts were performed during the treatment at the same segment (% yes)	16.9	19.5

[a] Responses are ordered according to prevalence at the first visit, from highest to lowest.
[b] Multiple responses possible.

Clinical Outcome Measures

The clinical outcome measures are presented for all time intervals in Table 4. Pain and disability of the neck steadily decreased up to 3 months, but there was no further improvement at 12 months. Approximately one fifth (21%, n = 105 of 509) and one half of the subjects (48%, n = 219 of 458) were recovered from their presenting complaint at the second and fourth visit, respectively, whereas approximately two thirds (65%, n = 308 of 476; 64%, n = 310 of 485) were recovered at 3 and 12 months, respectively. Of those recovered at 3 months, 18% (n = 55 of 308) were no longer recovered at 12 months; and of those not yet recovered at 3 months, 30% (n = 49 of 165) went on to recover at 12 months. Therefore, although the overall percentage of recovery at 3 and 12 months was approximately the same for the study population, at 3 months, some subjects continued to improve, whereas others that were recovered had recurrent symptoms. At 3 and 12 months, only 2 and 5 subjects, respectively, reported to be much worse. Most patients were moderately to highly satisfied with their chiropractors and their treatments throughout the study period, and most (range, 84%-99%) would visit a chiropractor again for this or any other spinal complaint.

Adverse Events After Treatment

Prevalence of Adverse Events. Forty-eight percent of those subjects who returned for a second visit indicated a new, related complaint or worsening of the presenting or existing complaint following the first visit (as reported at the second visit), and 26% of those who returned for a fourth visit indicated an adverse event following the second or third visit. In total, 56% of the study population indicated an adverse event following any of the first 3 treatments. At the second visit, most of the subjects (90%) indicated that the event began within 2 days of the treatment. Most (85% and 81% at the second and fourth visits, respectively) perceived the event to have no to minor influence on their activities of daily living.

Type, Frequency, and Severity of Adverse Events. In all, 571 and 166 adverse events were registered at the second and fourth treatments, respectively; and only a relatively small percentage of these adverse events were deemed to be severe in intensity (14% and 15%, respectively) (Table 5). The most common adverse events reported at the second and fourth visits were musculoskeletal or pain related (72% and 75% of all events, respectively). Individual nonmusculoskeletal adverse events such as tiredness, dizziness, nausea, or ringing in the ears were relatively uncommon (<8%), although 19% of the study population reported at least one nonmusculoskeletal adverse event at any of the first 3 treatments.

The total number of adverse events recorded by individual patients at the second and fourth visits are presented in Table 6. Of those subjects who had an adverse event at the second or fourth visit, the median number of events per patient was 2 (IQR, 1-3) and 1 (IQR, 1-1), respectively. In total, 13% (n = 67 of 529) reported an intense adverse event at any of the first 3 treatments. Of these, 64% (n = 43 of 67) reported only one intense event. However, none of the subjects with an intense adverse event were worse or much worse at the end of the study period. Finally, no serious adverse events were reported during the study period.

Discussion

In contrast to clinical trials of prescription medication, researchers in the area of conservative care for muscu-

Table 4. *Clinical outcomes for all measurements at baseline, second visit, fourth visit, 3 months, and 12 months*

Clinical outcome measures	Baseline (n = 529)		2nd visit (n = 509)		4th visit (n = 458)		3 mo (n = 476)		12 mo (n = 485)	
	n	%	n	%	n	%	n	%	n	%
Neck pain in the 24 h preceding the visit (0-10)[a]										
None (0)	28	5.4	20	4.0	32	7.0	103	21.6	124	25.6
Mild (1-3)	127	24.6	181	35.9	210	45.9	212	44.5	203	41.9
Moderate (4-7)	302	58.4	263	52.2	195	42.6	146	30.7	127	26.2
Severe (8-10)	60	11.6	40	7.9	21	4.6	15	3.2	30	6.2
Mean (SD)	4.8 (2.4)		4.3 (2.2)		3.6 (2.2)		2.8 (2.4)		2.8 (2.6)	
NDI (0-50)[b]										
None (0-4)	39	7.4	–		87	19.0	165	34.7	160	38.8
Mild (5-14)	298	56.9	–		283	61.8	241	50.6	193	46.8
Moderate (15-24)	160	30.5	–		80	17.5	59	12.4	49	11.9
Severe or "complete" disability (>25)	27	5.2	–		8	1.7	11	2.3	10	2.4
Median (IQR)	12.0 (8.0-17.0)		–		8.0 (5.0-12.0)		6.0 (3.0-11.0)		7.0 (3.0-11.0)	
Patient satisfaction										
Would you visit a chiropractor again for this or any other complaint? (% yes)	–		99.4		98.7		89.9		83.8	
Degree of satisfaction with the chiropractor (0-10)[c] (mean [SD])	–		7.7 (1.7)		7.8 (1.8)		7.7 (1.8)		7.6 (2.0)	
Treatment satisfaction (0-40)[d]	–		–		33.5 (5.2)		32.7 (6.3)		32.9 (6.7)	
Global assessment										
Completely improved			3	0.6	13	2.9	45	9.5	70	14.6
Much better			102	20.6	206	45.5	263	55.6	240	50.0
Somewhat better			194	39.2	175	38.6	107	22.6	83	17.3
Unchanged			145	29.3	39	8.6	50	10.6	67	14.0
Somewhat worse			43	8.7	18	4.0	6	1.3	15	3.1
Much worse			8	1.6	2	0.4	2	0.4	5	1.0

En dash (–) indicates missing or unrecorded data.
[a] Ranging from no pain (0) to excruciating pain (10).
[b] Ranging from no disability (0) to severely disabled (50).
[c] Ranging from not satisfied (0) to very satisfied (10).
[d] Ranging from not satisfied (0) to very satisfied (40) according to the scale from Cherkin et al.[28]

loskeletal complaints have focused their attention on treatment effectiveness and, to a much lesser degree, on adverse events. This study, consisting of patients treated in a wide variety of chiropractic practices and settings, describes both positive and negative, and short- and long-term clinical outcomes for a relatively large study population with neck pain. Although adverse events have been described in previous clinical trials of treatment effectiveness with cervical spine manipulation,[4,34] studies such as these provide limited information on these types of events because of their small sample sizes. Earlier studies on adverse events following spinal manipulation have focused on describing types and patterns of adverse events of the entire spine,[12-14,29] but did not describe positive outcomes. To our knowledge, only one other study has examined both positive and negative clinical outcomes in patients with neck pain undergoing chiropractic treatments[15]; however, our study has a larger sample size. In addition, given the study design chosen, it was possible to examine a large number of treatments delivered by a diverse group of chiropractors and was not specifically aimed at the effect of spinal manipulation alone. Therefore, these findings might be more generalizable to clinical practice than those obtained in a single-center, controlled trial setting.

In short, there are 2 major findings. Firstly, in relation to "risks," despite the fact that more than half of the study population experienced an adverse event, only 1% (5 subjects) of a cohort who had undergone 4891 treatment consultations reported to be much worse at the end of the study period; and there were no serious neurologic complications reported within this time frame. Although

Table 5. *Type, frequency, and severity of adverse events, and frequency of intense adverse events recorded at the second and fourth visits*

	2nd visit compared with baseline (n = 509)					4th visit compared with second visit (n = 458)				
			Intensity	Intense events[b]				Intensity	Intense events[b]	
Type of adverse event[a]	n	%[c]	Mean (SD)	n	%[c]	n	%[c]	Mean (SD)	n	%[c]
Increased treatment-related pain (musculoskeletal)										
Increased pain at the treated area[d]	148	29.1	5.0 (2.1)	20	3.9	7	1.5	4.7 (1.9)	0	0
Increased pain >30% in the 24 h preceding the visit	112	22.0	4.8 (2.0)	8	1.6	85	18.6	5.1 (2.0)	12	2.6
Increased pain at an other treatment-related area[c]	100	19.6	4.7 (2.4)	16	3.1	11	2.4	5.9 (2.3)	2	0.4
Headache	51	10.0	5.6 (2.3)	14	2.8	13	2.8	3.7 (1.9)	1	0.2
Radiating pain	–	–	–	–	–	9	2.0	5.3 (2.7)	3	0.7
Nonmusculoskeletal										
Tiredness or fatigue	39	7.7	5.9 (1.9)	8	1.6	8	1.7	4.0 (2.8)	1	0.2
Dizziness or light-headedness	38	7.5	5.0 (2.1)	5	0.9	6	1.3	3.8 (2.6)	0	0
Nausea	28	5.5	3.8 (2.2)	1	0.2	6	1.3	4.2 (2.2)	0	0
Ringing in the ears	19	3.7	3.4 (1.8)	0	0	4	0.9	3.0 (1.6)	0	0
Other type of adverse event[e]	13	2.6	5.6 (2.7)	4	0.8	9	2.0	6.8 (2.5)	6	1.3
Psychological										
Confusion or disorientation	14	2.8	4.9 (2.2)	1	0.2	6	1.3	1.5 (0.5)	0	0
Depression or fear	9	1.8	4.3 (2.4)	1	0.2	2	0.4	1.0 (0)	0	0
Total no. of events	571			78		166			25	

En dash (–) indicates unrecorded data (ie, no baseline comparison).

[a] As defined in the text.

[b] Defined as an adverse event that scored ≥8 in severity.

[c] Percentage of the total number of patients at that measurement period.

[d] For these symptoms, a reaction was considered to be any new symptom (ie, ≥1 on the 11-point NRS).

[e] Other complaints include strange feeling in the head, cannot focus/cannot see well, concentration problems/problems with trying to find words to express oneself, bad dreams, burning feeling (location unspecified), problems with jaw, neck "cracks," stomach pain, joints crack, tired/heavy arms, tingling in the fingers.

the number of patients with an intense adverse event seems high, none of these patients were worse or much worse at the end of the study period; therefore, these adverse events should in no way be misconstrued as a measure or indication of harm or be confused with (the lack of) perceived recovery. In addition, only 2 subjects reported to be much worse at 3 months, when most patients are likely to have completed or discontinued care.

Secondly, regarding "benefits," although many of the subjects had chronic, recurrent neck pain and had undergone prior care for this complaint, many patients experienced benefit from the treatment (based upon diminished pain and disability, the percentage of patients recovered and percentage satisfied with care). Furthermore, many responded relatively quickly to treatment (48% were recovered at the fourth visit); and a significant proportion of patients continued to improve up to 3 months (65%). It is, however, difficult to compare these findings to other studies, especially regarding the rate of recovery and involving other forms of therapy, because both the inclusion criteria and outcome measures may differ. The most similar study is a multicenter study of persistent low back pain treated by chiropractors.[35] Although the pattern of recovery was different, the percentage of patients who became worse was similarly low in both studies.

The results of this study also confirm earlier work that suggests that adverse events are most prevalent at the beginning of treatment and diminish thereafter in frequency.[13,14] This should have clinical consequences for the practitioner, who might choose to modify his/her treatment approach or limit himself/herself to certain interventions at the start of treatment when the patient is more likely to have a reaction.

Another important finding was that some of the same symptoms that are often viewed as a consequence of treatment, such as headache, nausea, dizziness, tiredness, or depression, were present in many subjects at baseline.

Table 6. *Total number of adverse events and severe adverse events observed in individual patients at the second and fourth visits*

	2nd visit (n = 509)				4th visit (n = 458)			
	Adverse event		Intense event[a]		Adverse event		Intense event[a]	
No. of events per patient	n	%	n	%	n	%	n	%
0	266	52.3	456	89.6	339	74.0	436	95.2
1	95	18.7	35	6.9	94	20.5	20	4.4
2	61	12.0	12	2.4	12	2.6	1	0.2
3	40	7.9	5	1.0	8	1.7	1	0.2
4	20	3.9	1	0.2	3	0.7		
5	15	2.9			1	0.2		
6	8	1.6			0	0		
≥7	4	0.8			1	0.2		

[a] Defined as an adverse event according to our definition, which also scored ≥8 in intensity on an 11-point NRS.

Furthermore, more than one fifth noted that the symptom was severe in intensity at baseline. This underlies the fact that without a proper reference, there is the real potential to erroneously ascribe previously unreported symptoms to the treatment. In fact, according to our study, many of these concomitant symptoms decreased following the first treatment and continued to improve following the second and third treatments. However, the prevalence of these symptoms returned to their baseline values at 3 and 12 months, suggesting either a short-term positive effect of the treatment or placebo effect.

There are some limitations to this study, however. Firstly, in relation to the data collection, the questionnaires used have not been previously validated, although they were modeled after previous side effects studies.[13,14] Furthermore, given the method of data collection in the clinics (ie, close-ended, self-reported questionnaires), the possibility of response bias cannot be ruled out, meaning it is possible that prompting a patient about the presence of a symptom via the questionnaires might have led to overreporting.

Secondly, the lack of a control group means that it cannot be determined whether the observed adverse events or recovery is a response to the treatment or the result of natural history. Although a control group is obviously desirable, studies such as this one are best designed to describe patterns and changes over time, to investigate the relationship between prognostic factors and outcomes, and to identify subgroups most likely to respond to manipulation for investigation in future clinical trials. Additional reports are forthcoming from this data set.

Thirdly, although this was a prospective study, there is also the potential for recall errors because patients were required to remember and report something about a reaction that took place at prior visit(s). However, almost all (90%) of the second visits had taken place shortly following the first visit, whereas most (79%) of the fourth visits took place within a month of the first visit, so this error is likely to be minimal.

Fourthly, because a convenience sampling of chiropractors was used to collect data, it is possible that more cautious and conservative chiropractors participated. However, a comparison of the practice characteristics of the participating chiropractors with the results of a recent study conducted in the Netherlands,[36] and with a relatively recent European study,[37] suggests that participants in this study were sociodemographically similar to their non-participating colleagues.

Fifthly, it is possible that those patients deemed by the practitioners likely to have a favorable outcome were more readily recruited. Analysis of recruitment in a sample of 5 of the participating practices revealed that, on average, 78% of the eligible patients were recruited; therefore, recruitment bias was likely to be minimal. Furthermore, practices that saw the highest number of new patients during the recruitment period recruited the fewest eligible patients; therefore, it seems more likely that failure to include individual patients was the result of time constraints in the practices.

Lastly, imaging of the cervical spine was only performed when necessary, at the discretion of the chiropractor. In the Netherlands, few chiropractors have their own radiograph apparatus; and few refer for imaging. Consequently, it is possible that underlying pathology might have been missed by the clinician. However, only one patient was found to have serious pathology; and she was identified at the beginning of the study (based upon history and physical examination) and was excluded from participation. Furthermore, we had a high follow-up rate at the end of the study and no other cases were identified during this period, so this is unlikely to have influenced our results.

Implications for Clinical Practice

Patients respond quickly to care, with the most dramatic improvement occurring in the first 3 treatments. After 3 months, a small percentage will have recurrent symptoms, whereas some will continue to improve; however, most of the patients remain stable. Clinicians should be aware that extended treatment programs might have limited added value when patients do not demonstrate some reasonable improvement by the fourth visit.

Implications for Research

Many symptoms resembling an adverse event were present in nearly all the subjects at baseline and diminished in frequency in the population during the first 3 months. This demonstrates the need to record baseline status for concomitant symptoms to avoid erroneously ascribing their incidence to treatment.

Conclusion

Despite the fact that adverse events following treatment are common, and in some cases severe in intensity, this study shows that the benefits of chiropractic care for neck pain seem to outweigh the potential risks.

Practical Applications

- Most patients in this study had chronic, recurrent complaints; mild to moderate disability of the neck; and a mild amount of pain at baseline.
- Approximately half of the cohort was recovered at the fourth visit from their presenting complaint, whereas approximately two thirds were recovered at 3 and 12 months.
- Fifty-six percent of the study population indicated an adverse event following any of the first 3 treatments, which was typically musculoskeletal or pain related and was mild to moderate in intensity. Only 5 subjects (1%) reported to be much worse at 12 months.
- Although adverse events are common, many patients benefit from treatment.
- For the participants in this study, the benefits of chiropractic care for neck pain seem to outweigh the potential risks.

Acknowledgment

This study was partially funded by The European Chiropractors' Union (grant number A.03-1) and by the Foundation for Chiropractic Education and Research (Fellowship number 06-03-04).

References

1. Borghouts JA, Koes BW, Vondeling H, Bouter LM. Cost-of-illness of neck pain in the Netherlands in 1996. Pain 1999;80:629-36.
2. Cote P, Cassidy JD, Carroll L. The Saskatchewan Health and Back Pain Survey. The prevalence of neck pain and related disability in Saskatchewan adults. Spine 1998;23:1689-98.
3. Gross AR, Hoving JL, Haines TA, et al. A Cochrane review of manipulation and mobilization for mechanical neck disorders. Spine 2004;29:1541-8.
4. Hoving JL, Koes BW, de Vet HC, et al. Manual therapy, physical therapy, or continued care by a general practitioner for patients with neck pain. A randomized, controlled trial. Ann Intern Med 2002;136:713-22.
5. Gabriel SE, Jaakkimainen L, Bombardier C. Risk for serious gastrointestinal complications related to use of nonsteroidal anti-inflammatory drugs. A meta-analysis. Ann Intern Med 1991;115:787-96.
6. Ofman JJ, MacLean CH, Straus WL, et al. A metaanalysis of severe upper gastrointestinal complications of nonsteroidal antiinflammatory drugs. J Rheumatol 2002;29:804-12.
7. Hallas J, Lauritsen J, Villadsen HD, Gram LF. Nonsteroidal anti-inflammatory drugs and upper gastrointestinal bleeding, identifying high-risk groups by excess risk estimates. Scand J Gastroenterol 1995;30:438-44.
8. Assendelft WJ, Bouter LM, Knipschild PG. Complications of spinal manipulation: a comprehensive review of the literature. J Fam Pract 1996;42:475-80.
9. Dziewas R, Konrad C, Drager B, Evers S, Besselmann M, Ludemann P, et al. Cervical artery dissection—clinical features, risk factors, therapy and outcome in 126 patients. J Neurol 2003;250:1179-84.
10. Haldeman S, Kohlbeck FJ, McGregor M. Risk factors and precipitating neck movements causing vertebrobasilar artery dissection after cervical trauma and spinal manipulation. Spine 1999;24:785-94.
11. Barrett AJ, Breen AC. Adverse effects of spinal manipulation. J R Soc Med 2000;93:258-9.
12. Cagnie B, Vinck E, Beernaert A, Cambier D. How common are side effects of spinal manipulation and can these side effects be predicted? Man Ther 2004;9:151-6.
13. Leboeuf-Yde C, Hennius B, Rudberg E, Leufvenmark P, Thunman M. Side effects of chiropractic treatment: a prospective study. J Manipulative Physiol Ther 1997;20:511-5.
14. Senstad O, Leboeuf-Yde C, Borchgrevink C. Frequency and characteristics of side effects of spinal manipulative therapy. Spine 1997;22:435-40.
15. Hurwitz EL, Morgenstern H, Vassilaki M, Chiang LM. Adverse reactions to chiropractic treatment and their effects on satisfaction and clinical outcomes among patients enrolled in the UCLA Neck Pain Study. J Manipulative Physiol Ther 2004;27:16-25.
16. Axen I, Rosenbaum A, Robech R, Wren T, Leboeuf-Yde C. Can patient reactions to the first chiropractic treatment predict early favorable treatment outcome in persistent low back pain? J Manipulative Physiol Ther 2002;25:450-4.
17. Axen I, Rosenbaum A, Robech R, Larsen K, Leboeuf-Yde C. The Nordic back pain subpopulation program: can patient reactions to the first chiropractic treatment predict early favorable treatment outcome in nonpersistent low back pain? J Manipulative Physiol Ther 2005;28:153-8.
18. Bolton JE, Wilkinson RC. Responsiveness of pain scales: a comparison of three pain intensity measures in chiropractic patients. J Manipulative Physiol Ther 1998;21:1-7.
19. Potter RG, Jones JM, Boardman AP. A prospective study of primary care patients with musculoskeletal pain: the identification of predictive factors for chronicity. Br J Gen Pract 2000;50:225-7.
20. Heijmans WFGJ, Lutke Schipholt HJA, Elvers JWH, Oostendorp RA. Neck Disability Index Dutch version (NDI-DV) bij chronische "whiplash" patienten: onderzoek naar de betrouwbaarheid. Ned Tijdschr voor Fysiotherapie 2006;112:94-9.
21. Macfarlane GJ, Thomas E, Croft PR, Papageorgiou AC, Jayson MI, Silman AJ. Predictors of early improvement in low back pain amongst consulters to general practice: the

influence of pre-morbid and episode-related factors. Pain 1999;80:113-9.
22. Beurskens AJ, de Vet HC, Koke AJ, Lindeman E, van der Heijden GJ, Regtop W, et al. A patient-specific approach for measuring functional status in low back pain. J Manipulative Physiol Ther 1999;22:144-8.
23. Feinstein AR. Clinimetrics. New Haven and London: Yale University Press; 1987.
24. Hurwitz EL, Morgenstern H, Vassilaki M, Chiang LM. Frequency and clinical predictors of adverse reactions to chiropractic care in the UCLA neck pain study. Spine 2005;30:1477-84.
25. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. J Manipulative Physiol Ther 1991;14: 409-15.
26. Vernon H. The Neck Disability Index: patient assessment and outcome monitoring in whiplash. J Musculoskelet Pain 1996;4:95-104.
27. Hains F, Waalen J, Mior S. Psychometric properties of the Neck Disability Index. J Manipulative Physiol Ther 1998;21:75-80.
28. Cherkin D, Deyo RA, Berg AO. Evaluation of a physician education intervention to improve primary care for low-back pain. II. Impact on patients. Spine 1991;16:1173-8.
29. Senstad O, Leboeuf-Yde C, Borchgrevink CF. Side-effects of chiropractic spinal manipulation: types frequency, discomfort and course. Scand J Prim Health Care 1996;14:50-3.
30. Farrar JT, Young JP, LaMoreaux L, Werth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. Pain 2001;94:149-58.
31. Vlaeyen JW, Kole-Snijders AM, Boeren RG, van Eek H. Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. Pain 1995;62:363-72.
32. van Ginkel JR, van der Ark LA. SPSS syntax for missing value imputation in test and questionnaire data. Appl Psychol Meas 2005;29:152-3.
33. Swinkels-Meewisse I. Pain-related fear in acute low back pain. The prognostic impact on performance, disability, and participation. Eindhoven, The Netherlands: University of Maastricht; 2006.
34. Bronfort G, Evans R, Nelson B, Aker PD, Goldsmith CH, Vernon H. A randomized clinical trial of exercise and spinal manipulation for patients with chronic neck pain. Spine 2001;26:788-97.
35. Leboeuf-Yde C, Gronstvedt A, Borge JA, et al. The Nordic back pain subpopulation program: a 1-year prospective multicenter study of outcomes of persistent low-back pain in chiropractic patients. J Manipulative Physiol Ther 2005;28:90-6.
36. Imbos N, Langworthy J, Wilson F, Regelink G. Practice characteristics of chiropractors in the Netherlands. Clin Chiropr 2005;8:7-12.
37. Pedersen P, Breen AC. An overview of European chiropractic practice. J Manipulative Physiol Ther 1994;17:228-37.