Comparison of two chiropractic techniques on pain and lateral flexion in neck pain patients: a pilot study

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ABSTRACT. *Musculoskeletal disorders affect 5–7% of the population in Canada. Neck pain is one of the more common musculoskeletal complaints. Spinal manipulative therapy attempts to reduce pain and increase range of motion. Treatments from any profession require valid evidence of efficacy. This study examines two popular treatments used by Canadian chiropractors, a mechanically assisted device commonly known as the Activator Adjusting Instrument™, and spinal manipulative therapy. Fourteen subjects were randomly assigned into two groups. Each subject was assessed by a blind examiner and then given one of the two treatment interventions provided by an experienced chiropractor. The outcome measures used were lateral flexion and a subjective pain rating scale. The results revealed that there were no statistically significant differences before and after the interventions. Further study is required using larger sample sizes before conclusions can be made regarding the efficacy of the selected interventions. However, the importance of the need for future comparative studies is discussed.*

KEY WORDS: Chiropractic Manipulation—Neck Pain—Cervical Vertebrae

MUSCULOSKELETAL DISORDERS AFFECT 5–7% of the Canadian population [1]. Neck pain is one of the more common musculoskeletal complaints [2, 3]. The purposes of a treatment are to reduce pain and improve function, regardless of the method selected. Most health professions suffer from a paucity of scientific validation of their treatment efficacy [4]. Treatments for cervical spine pain and dysfunction are included in this grouping.

New concerns for cervical spine manipulative treatment and its deleterious effects with respect to neurovascular accidents, as rare as these may be, have created a desire by the chiropractic profession to investigate methods that may provide similar results in terms of reduced pain and increased range of motion but provide the lowest risk possible. This risk/benefit ratio is an important component of any treatment evaluation, especially when the sequelae may include paralysis or death. Recently, the risk of chiropractic therapy for the cervical spine has been challenged, thus making the evaluation of treatments that may have less serious sequelae more important [5].

Six previously reported studies on manipulation of the cervical spine were reviewed. These studies are summarized in Table 1. Cassidy et al. published a randomized trial that compared the immediate effects of manipulation on pain and range of motion of the neck [6]. One hundred subjects were divided randomly into two groups. One group of 52 subjects received Diversified spinal manipulation (SMT) by an experienced chiropractor; the other group (n =

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Table 1
Summary of previous pertinent studies of cervical SMT, mobilization and adjunct treatment

Study	Type	Number of Subjects (*n*)	Treatment(s) performed
Cassidy et al. (7)	Randomized, controlled clinical trial	100	SMT, energy technique
Vernon et al. (8)	Randomized, controlled clinical trial	9	SMT, mobilization
Howe et al. (9)	Randomized, controlled clinical trial	52	SMT, facet joint injection
Nansel et al. (10)	Randomized, controlled clinical trial	69	SMT
Sloop et al. (12)	Randomized, controlled clinical trial	39	Diazepam-Amenesia, SMT

48) were mobilized using muscle energy technique. Each subject received only one intervention. Total range of motion of the cervical spine was evaluated using a goniometer and pain was measured using an NRS-101 pain scale instrument. The results indicated a global increase in range of motion after both SMT and mobilization treatment. In a previous pilot study, Cassidy et al. demonstrated that, after SMT, lateral flexion was the most improved range of motion bilaterally, followed by rotation ipsilaterally [7]. Subject's results were obtained immediately after the intervention ($\geq$ 5 min). Unfortunately, none of these differences were found to be statistically significant.

Vernon et al. measured pain thresholds of the cervical spine after SMT [8]. The algometer was used as an objective measure. They concluded that SMT produced significantly higher increases in pressure pain thresholds of tender points surrounding the fixation compared with the sham. In their opinion, mobilization did not qualify as a reasonable sham treatment. The findings were also limited by sample size (mobilization, $n = 4$; manipulation. $n = 5$). However, this study was one of the first to compare SMT with a similar treatment method using an objective measure of pain threshold.

Howe et al. applied SMT to 52 patients [9]. Although they reported statistically significant results in favor of manipulation, the methods of intervention included joint injection, thus distancing this study from common chiropractic practice.

Nansel et al. suggested that lateral flexion restrictions in the lower cervical spine, specifically C6–C7, benefited from SMT [10]. Nansel et al. stated that restriction in lateral flexion was not caused by a coupled restriction in rotation. They proposed that the amelioration of lateral flexion asymmetries of greater than 10° was primarily the result of specific manipulation to the lower cervical spine. In their study, all subjects were asymptomatic but demonstrated goniometric restriction of motion. Nansel et al. confirmed findings of lateral cervical spine flexion improvement after SMT in studies in a sample of students.

Nordemar and Thorner compared a cervical collar, transcutaneous electrical nerve stimulation and mobilization treatment, but could find no appreciable difference among treatment types [11]. The above studies are randomized controlled trials and their results have provided some rationale to further pursue the study of low-force, high-velocity SMT.

Sloop et al. also studied the effects of SMT and concluded that it made no significant improvement in the symptoms of tested subjects [12]. Interestingly, subjects were rendered amnesic to provide the double blind criteria necessary for inclusion into the sample population. Although the authors reported that they attempted to supply double blind criteria, the methodology did not allow the generalization of results to common clinical practice. Also, the effect of general anesthesia on joint function was not addressed.

In reviewing the literature, Bergmann stated that there have been no clinical trials comparing two different SMT methods [13]. He further stated that although studies of the treatment effectiveness of manipulation of the cervical spine have involved control groups that received various alternative treatments over various time frames, studies directly comparing the effectiveness of one chiropractic treatment technique with another had not yet been performed. Because none of these techniques have been compared with one another for efficacy, different treatment styles seem to have been developed and promoted in isolation. Thus, in consideration of the paucity of information available comparing treatment outcomes, this study compared two treatment types that are reported to be commonly used by Canadian chiropractors [14].

The two treatment types selected in the present study were chosen because of a recently published survey [14]. Chiropractors in Canada were surveyed regarding various aspects of their practices including, among other things, the number and type of techniques used to deliver a treatment. This survey provided insight into the treatment techniques used by Canadian chiropractors. Christensen reported the frequency of utilization of various treatments in each province; the technique reported to be most commonly used was the Diversified technique (SMT). The next most commonly reported technique was the sacro-occipital technique (SOT), followed very closely by usage of a mechanically assisted device (MAD).

The MAD, commonly referred to as the Activator Adjusting Instrument, is apparently popular among Canadian chiropractors, even though controlled trials using it have not been reported. Osterbauer et

al., in a pilot study, suggested that there are positive effects in using a MAD on patients with cervical spine dysfunction and pain [15]. However, two problems evident in his pilot study were that more than one type of intervention was applied and that the outcome measures reported were not practical.

Outcome measures selected for use in clinical trials must be reliable. Appropriately selected outcome measures play a very important role in assessing treatment outcomes and are frequently taken from randomized controlled trials. Although outcome measures for functional spine disorders have been evaluated and criticized, subjective assessment of cervical spine disorders has become an important outcome measure of treatment effectiveness [16, 17].

The Visual Analog Scale (VAS) has been shown to be an effective and reliable instrument for measuring patients' subjective interpretations of their pain [18, 19]. Pain intensity has been measured by subjects using a 10-cm VAS instrument. Wallace et al. suggested that the VAS provided a reliable, responsive measurement and was easily understood by patients [20]. He also suggested that the VAS was superior to other pain measurement instruments because, compared with a seven-point scale, it enabled patients to better discriminate small differences.

Duncan et al. suggested that the VAS provided more reliable results than a verbal measuring scale [21], and Triano et al., comparing six subjective outcome measures, concluded the VAS was both reliable and responsive [19]. Unfortunately, such reliability and simplicity of use are not properties of functional assessments, like range of motion (ROM).

One instrument used to measure ROM is the Cervical Range of Motion Meter (CROM). The CROM is a plastic instrument that is mounted on the patient's nose and fixed at the posterior skull by a velcro fastener (Fig. 1). Youdas et al. compared the CROM with other means of ROM assessment and found the CROM to be reliable and efficient in the clinical setting [22]. The other instrument in their study was the universal goniometer, which is hand-held and is placed next to the patient. A better intraclass correlation coefficient was demonstrated with the CROM. For these reasons, the CROM was used in our study.

Considering the lack of a comparison of two different yet common chiropractic techniques, a pilot study was designed. The purpose of this study was to assess whether there was a statistically significant difference in selected outcome measures between two different interventions. This pilot study would also provide some basis of speculation for future study comparisons of techniques used by Canadian chiropractors.

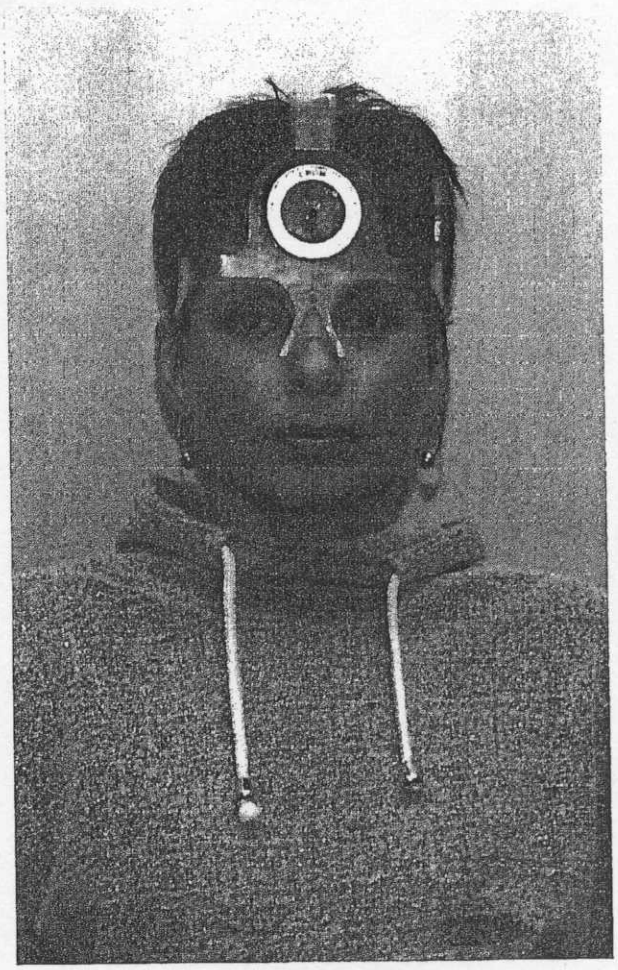

Fig. 1. CROM.

Question

Are there statistically and clinically significant pre-, post- and intertechnique differences between the lateral flexion ROM and VAS measurement in adult patients who present with cervical spine pain of > 3 wk duration when treated by SMT vs. a MAD?

METHODS

Design

Single-blind, randomized, comparative clinical trial.

Inclusion/Exclusion Criteria

All patients with unilateral neck pain of at least 3 wk duration (subacute) between the ages of 18 and 55 yr were included. Those patients who had had any SMT within the previous 90 days were excluded from the study. Patients with severe pathology, infection, or who were suspected of malingering were also excluded from this study.

Procedure

Subjects were selected from an active chiropractic practice over a period of 6 months; all spoke English

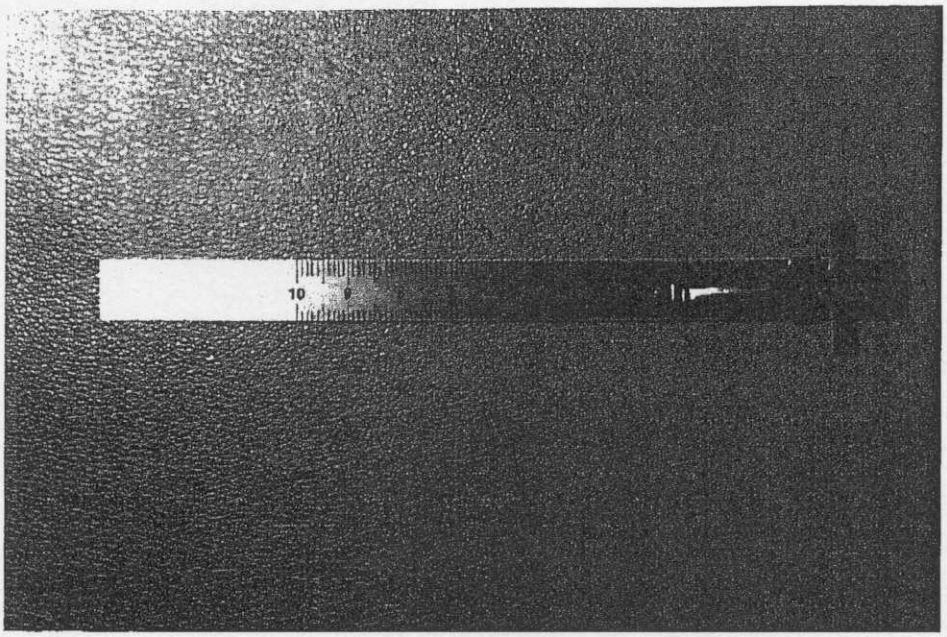

Fig. 2. Numbered side of VAS used only by the examiner.

and were functionally literate. Subjects from 18–55 yr old with unilateral neck pain were examined for eligibility by the doctor providing treatment. If the doctor determined that inclusion criteria were met, the doctor explained the study to the patient. Patients who agreed to participate in the study were asked to sign an Informed Consent form.

The subject was placed in a treatment room and introduced to the examiner. The examiner was a skilled fitness assessor trained in the use of the CROM. The examiner was blinded to the intervention. The examiner had the patient record his/her subjective impression of his/her neck pain using a VAS reading. The VAS reading was made by the patient using the blank side of the 10-cm VAS rule. This rule indicated only "worst" pain at one end and "absence" of pain at the other. After the patient indicated his/her pain severity on the rule, the examiner recorded the number from the back of the rule (Fig. 2).

The CROM goniometric (inclinometer) device manufactured by Performance Attainment Associates (St. Paul, Minnesota) was employed. The examiner stood in front of the patient and, with the patient's eyes closed, took the patient's head to an end point. All movements by the patient were passive, and the examiner assisted the patient's head to avoid any flexion/extension or rotation compromise.

The treating chiropractor chose the intervention in succession from a random numbers table. He reentered the room after the examiner left and administered only one intervention. The area of treatment was restricted to the lower cervical spine, specifically one vertebral level from the third to the seventh vertebrae inclusive. Treatments were performed according to accepted methods described by

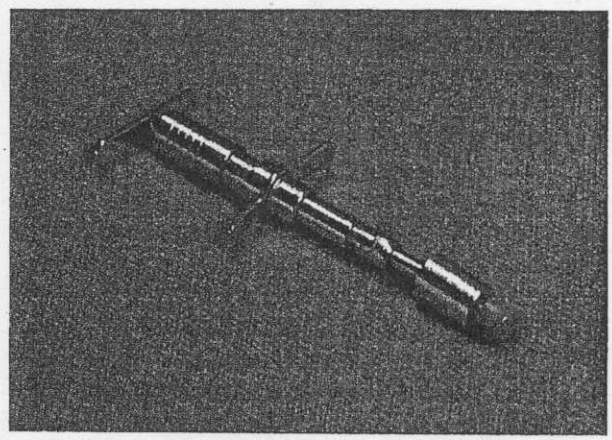

Fig. 3. MAD.

Haldeman for Diversified technique [23], and Petterson for the MAD method [24] (Fig. 3). Although Diversified SMT is described in various studies, our approach was similar in a more limited way to that of Koes et al., who allowed therapy in their study to be "at the discretion of the manual therapists" [25]. Haldeman described six Diversified treatments for the lower cervical spine [23]. Only two types of Diversified SMT procedures were considered for this study (the sitting cervical and the supine rotary cervical; Fig. 4). This study left the decision as to which of the two Diversified procedures to perform to the discretion of the treater. Motion palpation techniques were used to establish restricted motion in rotation and/or lateral flexion in the opposite direction of the putative side (contralateral side of restricted motion).

The MAD was applied in the prone position only, with the instrument placed at the "2 ring" position. We chose the "2 ring" setting for this study because

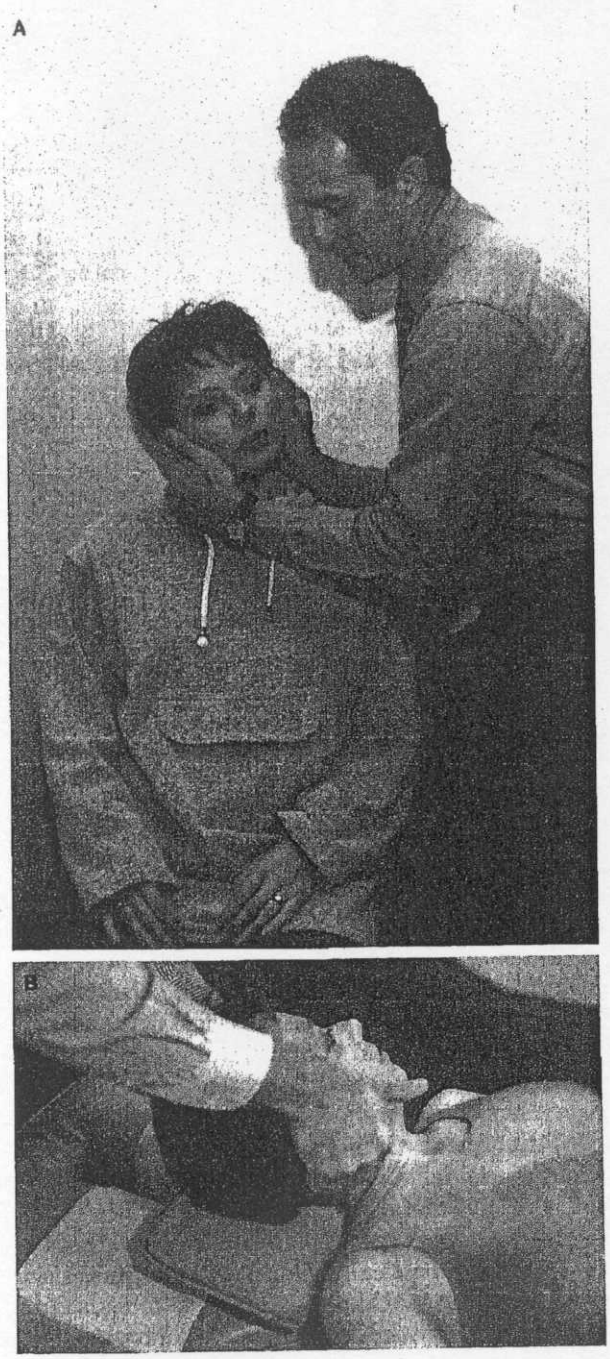

Fig. 4. ***A. A sitting cervical SMT. B. A supine cervical SMT.***

it is the lowest setting and is suggested setting for cervical spine and adjustment as recommended by Petterson [24]. After placing the instrument at the posterior pillar of the restricted lower cervical vertebrae, one "click" application of the instrument was given. No other soft tissue work was performed. This technique administration to the cervical spine is demonstrated in Figure 5.

Within 5 min of treatment, the examiner re-entered the room (blind to the intervention) and completed a second assessment series. The treating chiropractor was also blind to the data until the study was completed.

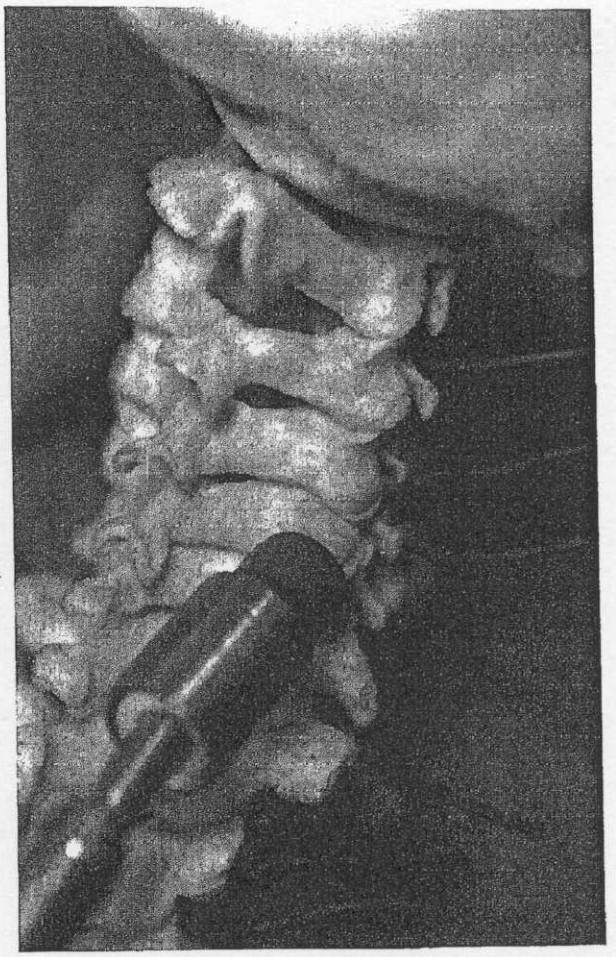

Fig. 5. MAD with skeleton.

Statistical Analysis

The pre-/post-treatment scores for the two techniques, MAD and SMT, were compared using the unpaired t test. Because pretreatment measurements differed to a significant degree, Analysis of Covariance (ANCOVA) was therefore used to minimize the difference between the SMT group and the MAD group.

RESULTS

Fourteen subjects participated in the study. No subject refused to participate. The mean age was 37.4 yr; the youngest was 21 and the oldest was 55. There were 11 female subjects and 3 male subjects.

The raw data for the pre- and postintervention outcome measures are listed in Table 2. Tables 3 and 4 summarize the mean and standard deviation scores for comparing left and right lateral flexion pretreatment measures, along with VAS pre- and post-treatment scores for SMT and MAD.

Unpaired t tests that compared all outcome measured pre/post changes between SMT and MAD are reported in Table 5; specifically, the differences in

Table 2
Raw data for selected outcome measures

Subject	Treatment type	Pretest LL Flex	Pretest RL Flex	Pretest VAS	VAS	Posttest LL Flex	Posttest RL FLex	Posttest VAS
1	SMT	32	29.5	15	−9	33+	35+	6
2	MAD	40	40	24	−24	51+	50+	0
3	SMT	34	30	17	−6	40+	33+	11
4	SMT	38	35	46	−14	33−	37+	32
5	SMT	19	25	28	−4	23+	29+	24
6	SMT	29.5	31	28	−18	35+	39+	10
7	MAD	58	45	15	−4	61+	58+	11
8	MAD	39	31	44	+1	41.5+	41+	45
9	MAD	28	39	56	−10	35+	39°	46
10	SMT	30	19	85	−20	39+	31+	65
11	MAD	28	32	30	−15	32+	32°	15
12	MAD	30	28	51	−30	40+	48+	21
13	MAD	36	33	10	−5	36°	40+	5
14	SMT	22	25	11	−6	29+	37+	5

LL, left lateral; RL, right lateral.

Table 3
Means and standard deviation for pre/post measures of left and right lateral flexion scores

	Pre LLF	Post LLF	Diff Pre/Post LLF	Pre RLF	Post RLF	Diff Pre/Post RLF
SMT	27.643 (5.677)	33.143 (5.843)	5.500 (2.432)	27.786 (5.211)	34.429 (3.599)	6.643 (4.130)
MAD	37.000 (10.534)	42.537 (10.250)	5.537 (4.000)	35.429 (5.024)	44.000 (8.583)	8.571 (7.115)

Table 4
Mean and standard deviation for pre/post measures of VAS scores

	VAS Pre	VAS Post	VAS Pre/Post difference
SMT	32.857 (25.777)	21.857 (21.459)	−11.000 (6.351)
MAD	32.857 (17.874)	20.427 (18.402)	−12.429 (11.267)

right lateral flexion, left lateral flexion, and VAS scores are reported.

Although the pretest measurements for left and right lateral flexion were different between the two treatment groups (Table 3), the Coefficients of Determination ($R2$) comparing the post-treatment measures and the covariates (pre-treatment measures) were > .6. ANCOVA was performed and the results are summarized in Tables 6 and 7. The probability (p value) with the ANCOVA of left lateral flexion in this case is .835. Although this p value is slightly smaller than the p value from the t test (p = .938), it is still not statistically significant. Because the p values with ANCOVA for left and right lateral flexion are .835 and .702, respectively, these results are also considered not statistically significant. With the multiple R correlation between pre and post measures greater than .7, the ANCOVA for this data also renders these results to be statistically insignificant. The ANCOVA multiple R for left and right lateral flexion are .942 and .768, respectively.

Because the pretreatment VAS data were similar between SMT and MAD, the unpaired t test comparing the pre/post changes between the treatment groups was judged to be a suitable test of statistical significance. The difference between the groups was not statistically significant (p = .775).

DISCUSSION

As has been previously discussed, Nansel et al. stated that SMT to the lower cervical spine seems to be specific for lateral flexion improvement (lessening of asymmetries) [10]. They found lateral flexion asymmetries were reduced with a sitting Diversified SMT treatment. Cassidy et al. found improvement in right and left (ipsilateral and contralateral) lateral flexion ROM after a single intervention to one side [6]. However, the reported differences were not found to be statistically significant differences with either SMT or MAD.

Comparison with Nordemar and Thorner's data is difficult because they used analgesic in their treatment protocol and "total range of motion" for pre/post testing [11]. Howes et al. used manipulation in a single-blind design [9]. Their results are not comparable with those of this study because manipulation was administered to any area deemed necessary by the treating doctor, and more than one intervention was applied. Joint injections and manipulation were regularly combined in the treatment protocol. In this study, all patients had at least a 3-wk interval of daily pain before entry into the study. The mean length of time for daily pain for the subjects tested was 16 wk.

Sloop et al. concluded that a single SMT had no value [12]. Their study clearly suffered from a Type 2 error, as did our study as well, it seems. In addi-

Table 5
Unpaired sample *t* test on the pre/post difference

	SMT ($n = 7$)			MAD ($n = 7$)		
	LLF	RLF	VAS	LLF	RLF	VAS
X	5.500	6.643	−11.000	5.357	8.571	−12.429
SD	2.432	4.130	6.351	4.090	7.115	11.267
t	.079	−.620	.292	.079	−.620	.292
p	.938	.547	.775	.938	.547	.775

LLF, left lateral flexion; RLF, right lateral flexion

Table 6
Analysis of covariance of left lateral flexion

Source	Sum-of-squares	*DF*	Mean-Square	F ratio	*p*
TX	0.585	1	0.585	0.046	.835
L Flex Pre	505.044	1	505.055	39.404	.001
LflexPretreatment	0.240	1	0.240	0.019	.533
Error	128.169	10	12.817		

Table 7
Analysis of covariance for right lateral flexion

Source	Sum-of-squares	*DF*	Mean-Square	F ratio	*p*
TX	5.357	1	5.357	0.155	.702
R Flex Pre	143.741	1	143.741	4.168	.068
RflexPretreatment	14.408	1	14.408	0.418	.533
Error	344.842	10	34.484		

tion, Sloop et al. used an eight-point numerical scale, which has been shown to be less reliable than the VAS. The authors also suggested that the pain improvement was attributable to the patient's desire to please the therapists. This may also be the case in our study, because all subjects were patients of the treating chiropractor.

Both treatment types seemed to yield clinically important improvement in lateral flexion measures and VAS scores. That is, all patients reported to be subjectively improved and all had increase in their ROMs. However, the analyses indicated that all between-treatment differences were statistically insignificant ($p > .05$).

Because of the small sample size, quasi-randomization would have probably lowered the pretest differences between treatment groups. The small sample size and statistically insignificant results (i.e., power less than 80%) are consistent with Type 2 error in each outcome measure—particularly for right lateral flexion. A sample size estimate was calculated using a power of .80, an alpha of .05, and the relatively small differences observed in this study. Sample sizes required were estimated to be 147, 652 and 7874 subjects in each group for right lateral flexion, VAS and left lateral flexion, respectively.

Although the results observed in this study showed a positive trend in clinical improvement and, in fact, subjects reported "feeling better," the small differences noted in the ROMs could be accounted for by the inherent error in examiner testing. The use of ROM devices to objectively record the reported subjective improvements by subjects remains an enigma. Clinical history, examination findings, and radiographic and other imaging techniques have all been suggested as potential outcome measures in future studies [25].

In our study, all the subjects (patients) were very cooperative when it was suggested that a 10–15 min examining and re-examining time was involved. Because the subjects were the treating doctor's own patients, subject compliance was very high; however, this may have created a bias whereby subjects reported inflated improvements to please the doctor.

CONCLUSION

A pilot study comparing two common chiropractic techniques used by Canadian chiropractors is presented. This study did find a trend toward clinical improvement; however, the differences observed are not statistically significant. Future studies comparing the effectiveness of one treatment with another should involve (a) stratification by age, (b) a multicenter format with at least 150 subjects per treatment group, and (c) a more pragmatic treatment protocol, incorporating several treatments per subject.

Chiropractic techniques, as well as treatment techniques of other therapists, should be under constant review to increase effectiveness and decrease risk. Currently, only consensus evaluation methods provide accepted clinical guidelines for treatment

decision-making [25]. Further study incorporating methodological revisions is recommended.

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