Research Paper Review

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Does inter-vertebral range of motion increase after spinal manipulation? A prospective cohort study

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Branney J & Breen A

Reviewed by Dr. Michael Haneline DC (Research Review Service)

ABSTRACT

Background

Spinal manipulation for nonspecific neck pain is thought to work in part by improving inter-vertebral range of motion (IV-RoM), but it is difficult to measure this or determine whether it is related to clinical outcomes.

Objectives

This study undertook to determine whether cervical spine flexion and extension IV-RoM increases after a course of spinal manipulation, to explore relationships between any IV-RoM increases and clinical outcomes and to compare palpation with objective measurement in the detection of hypo-mobile segments.

Method

Thirty patients with nonspecific neck pain and 30 healthy controls matched for age and gender received quantitative fluoroscopy (QF) screenings to measure flexion and extension IV-RoM (C1-C6) at baseline and 4-week follow-up between September 2012-13. Patients received up to 12 neck manipulations and completed NRS, NDI and Euroqol 5D-5L at baseline, plus PGIC and satisfaction questionnaires at follow-up. IV-RoM accuracy, repeatability and hypo-mobility cut-offs were determined. Minimal detectable changes (MDC) over 4 weeks were calculated from controls. Patients and control IV-RoMs were compared at baseline as well as changes in patients over 4 weeks. Correlations between outcomes and the number of manipulations received and the agreement (Kappa) between palpated and QF-detected of hypo-mobile segments were calculated.

Results

QF had high accuracy (worst RMS error 0.5o) and repeatability (highest SEM 1.1o, lowest ICC 0.90) for IV-RoM measurement. Hypo-mobility cut offs ranged from 0.8o to 3.5o. No outcome was significantly

correlated with increased IV-RoM above MDC and there was no significant difference between the number of hypo-mobile segments in patients and controls at baseline or significant increases in IV-RoMs in patients. However, there was a modest and significant correlation between the number of manipulations received and the number of levels and directions whose IV-RoM increased beyond MDC (Rho=0.39, p=0.043). There was also no agreement between palpation and QF in identifying hypo-mobile segments (Kappa 0.04-0.06).

Conclusions

This study found no differences in cervical sagittal IV-RoM between patients with non-specific neck pain and matched controls. There was a modest dose-response relationship between the number of manipulations given and number of levels increasing IV-RoM - providing evidence that neck manipulation has a mechanical effect at segmental levels. However, patient-reported outcomes were not related to this.

ANALYSIS

Author's Affiliations

Institute of Musculoskeletal Research & Clinical Implementation, Anglo-European College of Chiropractic, Bournemouth, United Kingdom.

Background Information

Research has shown that spinal manipulation or mobilization, exercise, analgesics, acupuncture and low level laser therapy offer short-term relief of non-traumatic neck pain, with spinal manipulation and mobilization performing somewhat better than other interventions (1).

Spinal manipulation has not only been shown to decrease pain, but there is evidence that function is improved as well, probably attributable to increased motion. Both passive and active regional cervical spine motion has been shown to improve immediately after spinal manipulation (2). However, since regional neck range of motion can be affected by pain, disability and fear of movement, the role of manipulation in directly improving motion is unclear.

Spinal manipulation is typically directed toward specific levels with the objective of improving inter-vertebral range of motion (IV-ROM), even though it is not known if this actually happens. Therefore, an accurate way of measuring maximum IV-ROM during neck bending is needed in order to explain the therapeutic effects of neck manipulation. Also, whether or not the detection of reduced motion by palpation as a basis for applying manipulation is valid needs to be confirmed.

It has been shown that inter-vertebral motion can be measured using quantitative fluoroscopy (QF) and the resulting fluoroscopic images of lumbar vertebrae can be tracked during lumbar motion. This type of imaging allows the measurement of true IV-ROM. However, this method has not yet been used extensively or validated in the cervical spine. Therefore, the purpose of this study was to explore the effects of neck manipulation on IV-ROM in the cervical spine using QF.

This study had four main objectives:

1. To determine the accuracy, measurement precision and minimal detectable change (MDC) in IV-ROM.
2. To determine whether IV-ROM during cervical spine flexion and extension increases after a course of spinal manipulation for non-specific neck pain and if so, the dose–response associated with such

change.
3. To determine whether IV-ROM changes correlated with patient reported outcomes.
4. To compare the frequency of finding IV-ROM hypomobility by palpation and QF measurement.

PERTINENT RESULTS

After initial screening, 30 patients and 30 healthy controls were included in the study. However, one patient's imaging study failed, so the associated data were not included in the analysis.

The patients received a mean of 1.3 (SD 0.4) neck manipulations per visit, with a mean of 10.7 (SD 3.5) manipulations over the course of the study.

At baseline, patients had somewhat less inter-vertebral motion in extension at levels between C1-6 (mean 5.7°) and less in flexion (mean 1.5°) than controls, although none of the differences were statistically significant.

Hypo-mobility was detected by palpation more frequently than it was by QF measurement. In addition, the agreement between examiners calling segments hypo-mobile and the frequency of measurements that were below hypo-mobility thresholds did not correlate very well.

The number of manipulations received correlated positively with the number of levels that increased in range beyond their minimal detectable changes (MDCs – Rho = 0.39, p = 0.043) at 4 weeks, which was considered modest, but significant. Also, significantly more levels showed increased IV-ROM in patients (13/16) who had at least 4 manipulations as compared with the same spinal levels in controls (2/23).

Improved PGIC scores of at least a 30% at the end of the treatment period were observed in 87% of the patients. However, the patient-reported outcomes did not correlate very well with changes in IV-ROM beyond MDC at any level.

Lastly, no serious adverse events were reported, although temporary increases in symptoms occurred in 19 out of 29 patients.

CLINICAL APPLICATION & CONCLUSIONS

One of the primary objectives of this study was to determine if cervical spine IV-ROM increases after spinal manipulation in patients with non-specific neck pain; however, no significant differences between baseline and post-intervention values were found. The study did provide some evidence that neck manipulation increases IV-ROM at segmental levels, although patient reported outcomes were not related to these increases.

At baseline, there were no significant differences in cervical sagittal IV-ROM between patients and matched controls. This finding is somewhat counterintuitive, given that it has been proposed that spinal manipulation is targeted at specific spinal levels in an effort to improve IV-ROM (3). If IV-ROM findings are similar between patients with cervical spine pain and matched controls, yet research has pointed to the effectiveness of spinal manipulation in these patients, perhaps some other mechanism is involved. On the other hand, patients did have significantly lower active regional motion ranges than

controls at baseline. This agrees with another study that reported significantly lower cervical ROM and increased movement variability in chronic neck pain patients as compared to controls (4).

The authors hypothesized that there would be a correlation between cervical manipulation and intersegmental motion; however, the data did not support that hypothesis.

STUDY METHODS

A cohort of patients with nonspecific neck pain who received spinal manipulation was compared to a matched cohort of healthy volunteers using changes in IV-ROM as the primary outcome measure.

Thirty subjects were recruited from among patients seeking treatment for neck pain at the outpatient clinic of a chiropractic college. Another group of thirty pain-free healthy controls was recruited from staff, students and visitors to the chiropractic college and an affiliated university.

Inclusion criteria for patients:

- mechanical neck pain (reproducible by neck movement/provocation tests),
- no identifiable etiology for neck pain e.g. infection, inflammatory disease,
- pain located within the area defined by the Neck Pain Task Force,
- self-reported pain rating of 3 or more on an 11-point numerical rating scale (NRS),
- pain of at least 2 weeks duration, and
- no contraindications to spinal manipulative therapy.

Exclusion criteria for patients:

- non-mechanical neck pain,
- depression history,
- litigation/compensation pending,
- manual therapy already received for this episode of neck pain,
- primary complaint of arm pain,
- traumatic onset of this neck pain episode, or
- central hypersensitivity as assessed by pressure algometry.

There were additional standard inclusion and exclusion criteria that applied to all participants, including the healthy volunteers.

Prior to beginning treatment, patients were examined by a final year chiropractic student intern, as well as by a chiropractic clinical tutor who confirmed the intern's examination. The examination determined the suitability for neck manipulation. Palpation findings for inter-vertebral motion were recorded, patients were queried for a history of depression in the previous year, and pressure algometry for the assessment for pain central sensitization was performed.

All participants received Quantitative Fluoroscopy screenings of cervical motion in flexion and extension at baseline and at 4 weeks.

At baseline and at 4 weeks, patients completed an 11-point pain NRS, the Neck Disability Index

(NDI), and the EuroQol EQ-5 L. The Patient Global Impression of Change (PGIC) and a single satisfaction question were only completed at 4 weeks.

The accuracy of the IV-ROM measurement was determined using a model made from dry human C4-5 vertebrae joined by a unidirectional plastic joint. Maximum IV-ROM was measured 10 times by one observer for each range and orientation.

The intra- and inter-observer repeatability of determining maximum IV-ROM for inter-vertebral levels C1-6 was studied using two trained observers (a chiropractor and a chiropractic student) who independently analyzed the first 10 participants recruited for maximum IV-ROM.

Interventions were administered a maximum of twice a week for 4 weeks. The treatments consisted of high velocity, low amplitude (HVLA) cervical spine manipulation using diversified techniques. When necessary, adjunctive therapies were utilized, including myofascial trigger point therapy and/or light massage, and hot/cold packs. Patients were allowed to take analgesics if required.

STUDY STRENGTHS / WEAKNESSES

This study represented a good attempt at explaining the mechanical effects of spinal manipulation in the cervical spine. Investigating this phenomenon has proven to be enigmatic thus far and much more research is needed.

Methodological and practical considerations to keep in mind regarding this study include:

- The authors indicated that there was high intra-subject variation at some levels which would limit the ability of the QF method to measure changes in sagittal IV-ROM.
- One patient's imaging study failed and the associated data were not included in the analysis. Nonetheless, it does not appear that an intention-to-treat analysis was performed.
- This study only investigated IV-ROM in the sagittal plane. The results may have been different in other planes of movement.

Additional References

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