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Research Paper Review

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Distribution of cavitations as identified with accelerometry during lumbar spinal manipulation

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Reviewed by Dr. Shawn Thistle DC (Research Review Service)

ABSTRACT

Objective

This project determined the location and distribution of cavitations (producing vibrations and audible sounds) in the lumbar zygapophyseal (Z) joints that were targeted by spinal manipulative therapy (SMT).

Methods

This randomized, controlled, clinical study assessed 40 healthy subjects (20 men, 20 women) 18 to 30 years of age who were block randomized into SMT (group 1, n = 30) or side-posture positioning only (group 2; control, n = 10) groups. Nine accelerometers were placed on each patient (7 on spinous processes/sacral tubercles of L1-S2 and 2 placed 3 cm left and right lateral to the L4/L5 interspinous space). Accelerometer recordings were made during side-posture positioning (groups 1 and 2) and SMT (group 1 only). The SMT was delivered by a chiropractic physician with 19 years of practice experience and included 2 high-velocity, low-amplitude thrusts delivered in rapid succession. Comparisons using $\chi(2)$ or McNemar test were made between number of joints cavitating from group 1 vs group 2, upside (contact side for SMT) vs downside, and Z joints within the target area (L3/L4, L4L5, L5/S1) vs outside the target area (L1/L2, L2/L3, sacroiliac).

Results

Fifty-six cavitations were recorded from 46 joints of 40 subjects. Eight joints cavitated more than once. Group 1 joints cavitated more than group 2 joints ($P < .0001$), upside joints cavitated more than downside joints ($P < .0001$), and joints inside the target area cavitated more than those outside the target area ($P < .01$).

Conclusions

Most cavitations (93.5%) occurred on the upside of SMT subjects in segments within the target area (71.7%). As expected, SMT subjects cavitated more frequently than did subjects with side-posture positioning only (96.7% vs 30%). Multiple cavitations from the same Z joints had not been previously reported.

ANALYSIS

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Background Information
Most of us utilize spinal manipulative therapy (SMT) every day to help our patients and treat a variety of ailments. We, and our patients, normally want to hear the 'pop' (or cavitation)! During an adjustment, theory suggests that facet joint surfaces are gapped, creating an intra-articular vacuum that draws gas into the joint space (out of the joint fluid?), producing vibrations in addition to the 'pop'. This noise, combined with the gapping of one or multiple facet joints is thought to directly relate to the clinical effects of SMT in numerous ways.

Whether through the break-up of connective tissue adhesions within the joint, stimulation of afferent nerve fibers in the joint capsule or surrounding musculature, or a neurological or immunological reflex, it is thought that joint gapping and cavitation can both result in clinical and measurable effects (1, 2). In fact, joint gapping and cavitation have been so neatly intertwined that cavitation is often considered to be a sign that the joint has achieved end-range motion and that the manipulation was in fact successful.

Several studies have been conducted examining the general relationship between cavitation and clinical outcome (3, 4), and a recent study investigated the relationship between joint gapping and cavitation (5). However, none has examined the specific levels from which these cavitations originate (most only ask clinicians to indicate that a cavitation was heard during treatment). Interestingly, many of us assume that we know which specific levels cavitate when we deliver an adjustment, despite the lack of credible laboratory research to support this assertion. In fact, there is some evidence to suggest that we are not as accurate as we think (6)!

As research on SMT evolves, it can help us clarify historical theory and our understanding of the mechanisms behind what we do. There is currently a need for more research exploring the mechanisms and consequences of cavitation during SMT, particularly in the lumbar spine. This study aimed to determine the location and distribution of cavitations in the lumbar spine during side posture positioning and lumbar SMT in healthy subjects.

The authors hypothesized that upside lumbar facets would cavitate more frequently than downside joints, and that joints within the treatment target region would cavitate more frequently than those outside the region.

PERTINENT RESULTS

- 56 cavitations were recorded from 46 joints of the 40 subjects.
- Eight joints cavitated more than once (this is the first study to demonstrate this!).
- Group 1 (SMT) joints cavitated more than group 2 joints ($P < 0.0001$) – 96.7% vs. 30% of subjects overall.

- Upside joints (on the contact side) cavitated more frequently than downside joints ($P < 0.0001$), representing 93.5% of all cavitations.
- Joints inside the target area cavitated more (71.1% of all cavitations) than those outside the target area ($P < 0.01$).

CLINICAL APPLICATION & CONCLUSIONS

The results of this study may strike you as predictable, but just because we believe something to be true doesn't mean we should not investigate and validate! Considering the results above, it does appear that, at least in healthy younger subjects, more cavitations occur on the upside (contact side) and typically occur in the targeted region during side-posture lumbar manipulation. As mentioned in the introduction, this is one of the first studies to investigate the specific location and origin of cavitations in the lumbar spine during SMT.

Further research is needed on clinical populations in other age ranges, and these results cannot be extrapolated to the cervical or thoracic regions. Readers should also keep in mind that this study did not evaluate the association between the cavitations recorded and joint gapping at those specific levels (these authors have investigated this in other work [5]), or the relation between cavitation and clinical outcomes.

STUDY METHODS

This was a randomized, controlled, clinical study involving 40 healthy subjects (20 men and 20 women, 18-30 years of age). Participants had no history of low back pain lasting longer than two weeks, or no more than three episodes of LBP of brief duration (1-2 weeks) in any given year. Subjects were block randomized into SMT (group 1, n = 30) or side-posture positioning only (group 2; control, n = 10) groups. Nine accelerometers were placed on each patient (7 on spinous processes/sacral tubercles of L1-S2 and 2 placed 3 cm left and right lateral to the L4/L5 interspinous space).

Accelerometer recordings were made during side-posture positioning (groups 1 and 2) and SMT (group 1 only). The SMT was delivered by a chiropractor with 19 years of practice experience and included 2 high-velocity, low-amplitude thrusts delivered in rapid succession. A side-posture technique was used with a hand contact on the inferolateral sacrum (to avoid contact with the accelerometers).

Comparisons were made between groups to evaluate the number of joints cavitating from the upside (contact side for SMT) of group 1 vs. group 2 vs. the downside of each group, as well as which facets joints cavitated within the target area (L3-S1) vs. outside the target area (L1-L3, sacroiliac joint).

STUDY STRENGTHS / WEAKNESSES

Study Strengths

- This was the first study to employ advanced accelerometer recording and computation techniques, allowing the investigators to determine precise levels and location of cavitations.
- Comprehensive and consistent accelerometer placement was described and employed.
- Appropriate reliability studies for actually measuring cavitations and assessing agreement among clinicians, subjects and accelerometer readings were described and performed prior to data collection.

Weaknesses

- This study included only healthy subjects that were relatively young. This is a prudent tactic for a first study on this topic as it removes the potential for confounders such as facet degeneration etc. Future studies should include additional subject populations including clinical LBP patients.
- The contact on the inferolateral sacrum, although successful for avoiding contact with the accelerometers, created a relatively long-levered manipulation (not a weakness as much as a consideration).

Additional References

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