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Research Paper Review

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The effect of spinal manipulative therapy on experimentally induced pain: a systematic literature review

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ABSTRACT

Background: *Although there is evidence that spinal manipulative therapy (SMT) can reduce pain, the mechanisms involved are not well established. There is a need to review the scientific literature to establish the evidence-base for the reduction of pain following SMT.*

Objectives: *To determine if SMT can reduce experimentally induced pain, and if so, if the effect is i) only at the level of the treated spinal segment, ii) broader but in the same general region as SMT is performed, or iii) systemic.*

Design: *A systematic critical literature review.*

Methods: *A systematic search was performed for experimental studies on healthy volunteers and people without chronic syndromes, in which the immediate effect of SMT was tested. Articles selected were reviewed blindly by two authors. A summary quality score was calculated to indicate level of manuscript quality. Outcome was considered positive if the pain-reducing effect was statistically significant. Separate evidence tables were constructed with information relevant to each research question. Results were interpreted taking into account their manuscript quality.*

Results: *Twenty-two articles were included, describing 43 experiments, primarily on pain produced by pressure (n = 27) or temperature (n = 9). Their quality was generally moderate. A hypoalgesic effect was shown in 19/27 experiments on pressure pain, produced by pressure in 3/9 on pain produced by temperature and in 6/7 tests on pain induced by other measures. Second pain provoked by temperature seems to respond to SMT but not first pain. Most studies revealed a local or regional hypoalgesic effect whereas a systematic effect was*

unclear. Manipulation of a "restricted motion segment" ("manipulable lesion") seemed not to be essential to analgesia. In relation to outcome, there was no discernible difference between studies with higher vs. lower quality scores.

Conclusions: *These results indicate that SMT has a direct local/regional hypoalgesic effect on experimental pain for some types of stimuli. Further research is needed to determine i) if there is also a systemic effect, ii) the exact mechanisms by which SMT attenuates pain, and iii) whether this response is clinically significant.*

ANALYSIS

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Background Information
Pain is a growing area of research that spans many disciplines. We understand that pain stems from our nociceptors and we understand the various ways to induce pain. By now we also know, clinically and scientifically, that spinal manipulative therapy decreases pain in low back and neck pain populations. However, the mechanisms behind the pain reduction associated with SMT are not well established.

Review of Pain Mechanisms:
Before we get into the nuts and bolts of this study lets go over a quick, general review of pain, pain modulation and the possible mechanisms behind SMT. Pain originates from different types of nociceptors – mechanosensitive, thermosensitive, chemosensitive and polymodal nociceptors. Some types of noxious stimuli are transmitted to the dorsal grey matter of the spinal cord which sends axons across the midline of the cord to ascend to the thalamus, and eventually to the cerebral cortex. Impulses are transmitted through other pathways and mechanisms that may have analgesic effects on the spine and supraspinal levels. The acute pain we feel is quickly transmitted through the Aδ fibers which produce a sharp and “pricking” sensation that is very specific in location. The more chronic pain, which is transmitted slowly through the nociceptive C-fibers, is described as dull and aching pain that is poorly localized.

The concept of pain modulation helps us understand how pain is felt differently by each individual person. Central sensitization, a type of pain modulation, increases pain sensation in people who have had the pain for a long period of time. These people are more sensitive to new stimuli that might not be painful under normal circumstances. Segmental (afferent) inhibition, another type of pain modulation, can block an ongoing pain sensation through higher priority stimuli reaching the brain first. Descending antinociceptive systems, another modulating mechanism, can be influenced by blocking nociceptive information before it reaches higher centers. One last modulating mechanism is through subjective assessment and motivational-affective modulation. The limbic and sensory brain regions have pain-modulating systems that can be altered through expectations, and feelings/emotions such as fear.

As we also know, SMT is thought to have a number of effects, ranging from reducing stiffness or

increasing motion in a particular area of the spine, to a variety of potential neurological effects, one of which is reducing pain.

This study investigated, through a systematic review of the literature, if SMT can reduce pain at the level of the treated spinal segment, in the broader region of the SMT and/or systemically. This type of research, to the author's knowledge, had only been published once before (1). This research hypothesized that SMT can influence pain through local, regional or central means. Pain reduction at the level of the manipulation is thought to stem from a decrease in the sensitivity of the muscle spindles and/or the various segmental sites of a reflex pathway. Regional pain reduction is suggested to occur through an effect on the dorsal horn of the spinal cord or on the periaqueductal grey area. The reflex neural outputs to muscles and visceral organs are affected by SMT through both paraspinal muscle reflexes and motoneuron excitability. Lastly, central sensitization may also be modulated by altering central sensory processing via the removal of subthreshold mechanical or chemical stimuli from paraspinal tissues.

Specific questions that were examined through the systematic review included:

1. Does SMT reduce pain provoked by pressure?
2. Does SMT reduce pain provoked by temperature?
3. Does SMT reduce pain provoked by methods other than pressure and temperature?
4. Does SMT reduce experimentally induced pain at the spinal segment where it is performed?
5. Does SMT reduce experimentally induced pain in the spinal region where it is performed?
6. Does SMT have a systemic (global) effect on experimentally induced pain?

PERTINENT RESULTS

The systematic review of the literature identified 1279 titles. Upon scrutinizing the full text of each title, 22 articles were selected that fulfilled the inclusion criteria. These 22 articles described 43 experiments:

- 27 with pain produced by pressure
- 9 by temperature
- 3 by capsaicin
- 2 examined spontaneous pain
- 1 used a stretch test to produce pain
- 1 used electrically induced pain

Generally speaking, the majority of the studies were classified as moderate in quality. It should be noted that the manipulation of a restricted motion segment seemed to NOT be essential to analgesia. In addition, there was no discernible difference between studies with higher vs. lower quality scores.

The results of the questions listed above are as follows:

7. SMT reduced pain in the majority of the studies. These studies demonstrated a clear hypoalgesic effect of SMT in 19/27 experiments on pressure pain.
8. There were 9 experiments on pain induced by temperature, only 3 of which showed a hypoalgesic action for SMT.
9. Twenty experiments investigated whether SMT reduces experimentally induced pain in the spinal segment where it is performed. Twelve of them showed a hypoalgesic effect. The other 8 presented

no significant effects.

10. Seven tests were performed using methods other than pressure and temperature to induce pain. Six of these revealed a statistically significant hypoalgesic effect induced by SMT.
11. Nine experiments reported a regional effect of SMT on pain. Only one study failed to obtain a hypoalgesic effect.
12. Nine experiments evaluated the systemic effect of SMT on experimentally induced pain. None had blinded assessors. Five demonstrated a systemic action of SMT on pain, but 4 of them did not show significant differences between treatment groups. Three of these 4 evaluated first pain transmitted by Aδ fibers. The results of a systemic effect were unclear.

CLINICAL APPLICATION & CONCLUSIONS

The results from this study demonstrated that SMT had significant effects on pain, both locally and regionally. The effects of SMT on distant parts of the body were indeterminate and further research is required to investigate this possibility. The study also found that the outcome differs according to the method of pain induction. SMT was found to have significant effects when pain was induced by pressure, electricity, stretching of painful tissue, or dermal irritation. Conversely, SMT was not helpful when pain was induced through temperature means.

The results from this study would seem to be robust. For example, SMT was shown to increase pain pressure threshold by 4.8-44.6%. The important question that arises from these results is whether these changes are clinically significant? Previous research that demonstrated clinically important cut-off points for improvement in pain were not based on experimentally induced pain. So we must ask ourselves: What is the true cut-off point that is clinically significant for experimentally induced pain?

Nonetheless, the results from this study did give us information that can be applied to clinical practice. Manipulation of a particular segment was not required to have an effect. Identification of a manipulable lesion and the exact level and side of the manipulation (specificity) may not be imperative for pain relief and treatment success. Since the results are from experimentally induced pain, they do need to be interpreted with caution as discussed above.

One final point that I would like to make pertains to the control groups used in these types of studies – they tend to be problematic. Many researchers and publications require a sham procedure and control group to elucidate true meaning from study results. Ideally, SMT should be matched against a suitable sham treatment and control procedure. The authors from this study found that to be the case in 12 studies. Many of the other studies, that did not use sham/control groups, did provide alternatively creative ways to test their study questions by using naïve study subjects and different types of treatments. There were no obvious differences in the results from these two types of studies, which indicates that there might indeed be an effect aside from expectation. Those that dismiss these types of results truly do not see the forest for the trees – sometimes the big picture is truly what's important.

STUDY METHODS

The authors of this study undertook a systematic critical literature review for experimental studies on healthy volunteers and people without chronic syndromes, in which the immediate effect of SMT was tested. Articles that were chosen were reviewed by two authors in a blinded fashion. A summary quality score was calculated to indicate level of manuscript quality. Descriptive data was extracted from the

articles through a systematic critical literature review on the effect of SMT on pain. If the pain-reducing effect was statistically significant these outcome were considered positive. The study used several research questions that were formulated prior to the article selection. Separate evidence tables were constructed with each research question and their results. The information was interpreted taking into account each manuscript's quality.

STUDY STRENGTHS / WEAKNESSES

These types of systematic reviews are flawed in the sense that the criteria of study inclusion and their rated quality is made up by the authors. There is no accepted and validated quality check list for the type of experimental studies examined. The authors chose their own quality criteria that were based on concepts important to the author's research questions. Any type of modification to this check list could affect the interpretation of the studies assessed. By changing the criteria ever so slightly the studies examined could have been rated as better or worse depending on the criteria selected. However imperfect this science is, these types of studies with their good intentions and quality thought processes towards the study design still elucidates a wealth of knowledge that is important towards developing better evidence-informed healthcare practices.

From a systematic review process, this is a strong study that utilized two reviewers that independently analyzed the studies and extracted the results. There was no arbitrary threshold for acceptable quality, and the check list tables are detailed to allow readers to perform their own analysis of the information provided. It was also possible to examine several research questions due to the large number of studies examined.

Additional References

1. Coronado RA, Gay CW, Bialosky JE, Carnaby GD, Bishop MD, George SZ: Changes in pain sensitivity following spinal manipulation: A systematic review and meta-analysis. Journal of Electromyography and Kinesiology 2012.