

THE THERAPEUTIC BENEFIT OF THE AUDIBLE RELEASE ASSOCIATED WITH SPINAL MANIPULATIVE THERAPY

A Critical Review of the Literature

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Abstract:

Objective: To review the available literature pertaining to the therapeutic benefits of the audible release associated with spinal manipulative therapy. A critical appraisal of the scientific literature, empirical evidence and theories relating to this aspect of manipulation is presented.

Data Source: A broad based search of the English language literature was conducted utilising the databases Medline (1966-1998), Mantis (Health Index) (1880-1998) and Cumulative Index to Nursing and Allied Health (CINAHL) (1982-1998), using the key words crack/ing, cavitation, audible release, gapping, sound/s, noise/s, vibration, biomechanics, coupled with joint, articular, manipulation, spinal manipulation and spinal manipulative therapy. A manual search was also conducted of non-indexed journals and text books relating to manual therapy of the library of RMIT University, Bundoora, Victoria as well as a broad based Internet search.

Results: There is a paucity of scientific research relating to this specific aspect of spinal manipulative therapy. Although there is ample empirical evidence to support some therapeutic benefit from the audible release, only one scientific study specifically relating to this topic was uncovered.

Conclusion: Currently there is little scientific evidence to support any therapeutic benefit derived from the audible release and in fact, it appears the available evidence tends to refute many of the alleged beneficial effects. Given that many practitioners and patients alike place an importance on this aspect of manipulation further research is required in order to fully investigate this phenomenon.

Key Indexing Terms: Audible release, cavitation, joint crack, joint noise, joint sound, vibration, spinal manipulative therapy.

INTRODUCTION

Spinal manipulative therapy (SMT) is becoming widely accepted as an effective treatment for spinal pain of mechanical origin (1). There are many theories regarding

the mechanism responsible for the beneficial effects of SMT, including the release of entrapped synovial folds or plica, relaxation of hypertonic muscles by sudden stretching, disruption of articular or peri-articular adhesions and unbuckling of motion segments that have undergone disproportionate displacements (2). Of the numerous SMT techniques the high velocity low amplitude thrust technique (HVT) is one of the oldest and most widely used forms of manual medicine and remains one of the most frequently used forms of manual medicine (3,4). When applied, to a hypomobile spinal segment, one of the primary aims of this technique is the sudden separation of the opposing apophyseal joint facets (5), which in the opinion of some authors is responsible for the therapeutic benefits associated with this therapy (5-7). The HVT is usually accompanied by a cracking sound, or audible release (7-9), which is considered by some authors to be either essential for the success of the treatment (10), or at least an important part of the process (7,11,12). The manipulative crack has also been described as the phenomenon that separates manipulation from mobilisation (13,14). Other authors on SMT place little significance on the joint crack but most agree that if nothing else it does indicate that the joint surfaces have indeed been separated (4,15,16). Based on earlier research, on manipulation of the metacarpophalangeal (MCP) joint (7,14,17), it appears that the audible release is associated with a rapid separation of the joint surfaces and cavitation within the intra-articular fluid. Furthermore, it has been hypothesised that the audible release may be the mechanism responsible for initiating certain reflex responses associated with SMT (18). This review will investigate the scientific literature, as well as explore empirical evidence and commonly held beliefs on the therapeutic effect of the articular crack.

METHODS

A broad based search of the English language literature was conducted utilising the databases Medline (1966-1998), Mantis (Health Index) (1880-1998) and Cumulative Index to Nursing and Allied Health (CINAHL) (1982-1998), using the key words crack/ing, cavitation, audible release, gapping, sound/s, noise/s, vibration, biomechanics, coupled with joint, articular, manipulation, spinal manipulation and spinal manipulative therapy. A manual search was also conducted of non-indexed journals

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and text books relating to manual therapy of the library of RMIT University, Bundoora, Victoria as well as a broad based Internet search.

RESULTS

A number of textbooks and journal articles make comment on a variety of beneficial effects related to the audible release. This empirical evidence will be addressed under the Discussion section of this paper.

Only two scientific papers were located, which specifically investigated aspects of the therapeutic effects of the audible release (19,20). However, one of the papers, Herzog et al (19), was only a pilot study, being a precursor to a larger and more comprehensive study (20). The purpose of these studies was to investigate any electromyographic (EMG) reflex responses associated with SMT, for both manipulations which produced an audible release, and for manipulations which did not. Forty-six fast HVT manipulations and forty slow manipulations were applied to eleven asymptomatic volunteers. Each subject first underwent one or two slowly applied manipulations, followed by one or two fast manipulations (HVT) to the T3, T6 and T9 vertebral levels. The second fast HVT was only administered if the first failed to result in an audible release. All manipulations were applied to the left transverse process of the target vertebra by an experienced chiropractor, utilising a reinforced hypothenar contact and in a posterior to anterior direction. The slow manipulations were performed using a gradual increase in thrust pressure over a period of 3-4 seconds, while the fast manipulations were in accordance with accepted HVT procedure and lasted approximately 100 msec. The authors endeavoured to reach approximately the same peak force for both fast and slow manipulations. The forces applied during all SMT procedures were measured using a thin flexible pressure pad, while the audible release or cracking sound was detected using a small uniaxial accelerometer. EMG responses were measured via three pairs bipolar electrodes placed on the skin surface, opposite to the side of thrust, and immediately distal and proximal to the vertebral bodies of T3, T6 and T9. A fourth pair of electrodes was placed on the ipsilateral side to the thrust at approximately the T12 level.

Of the forty-six fast manipulations fifteen resulted in an audible release, while five of the forty slow manipulations also resulted in an audible release. All fast manipulations, whether accompanied by an audible release or not, evoked an EMG response of the muscle opposite the treatment area. These signals lasted on average 120 msec and with a latency of 50-200 msec, after the beginning of the thrust. The authors also mention that an EMG response from the electrodes on the same side as the thrust was

recorded, however, these responses tended to occur later than those evoked on the opposite side to the thrust. All of the slow manipulations did not result in any distinct EMG response, regardless of whether an audible release was elicited or not. The authors theorised that the short burst EMG signals, 120 msec, were consistent with the initiation of type II articular receptors, which when stimulated generate changes in joint muscle tone. Associated reflex responses may result in either inhibitory actions, leading to relaxation of spastic muscles, or may be excitatory in nature. Further, these reflex responses appear to be not only confined to those muscles adjacent to the stimulated joint capsule but may also effect muscles somewhat distant from the region where the SMT is applied (21).

On the basis of their results the researchers concluded that joint cracking sounds do not evoke a measurable reflex response, at least for the audible sounds recorded in their study.

DISCUSSION

In the above study the authors qualify their conclusions by stating that the audible sounds recorded in their study may in fact not be generated from the target vertebra but at some other vertebral level and therefore, any associated reflex responses may not have been captured by the EMG sensors. Further, it is possible that the recorded cracking sounds emanated from the costovertebral joints and not the facet joints, as assumed. The main EMG sensors were placed on the contralateral side to the thrust, and although one set of electrodes was placed on the ipsilateral side they may not have recorded some reflex responses evoked on that side of the thrust. Some recent research which investigated the relationship between the side of thrust and the audible release tends to support this speculation (22). In a commentary (23), one of the researchers also states that the audible release has, by common opinion, been associated with a cavitation process but that this opinion has not been scientifically tested. The placement of the EMG sensors on the skin surface may also have effected the results, as reflex responses may have been initiated in the deeper spinal muscles and thus not be detectable by the surface electrodes. The reliability and validity surface EMG studies has also been questioned due to possible interference from the electrical supply, mechanical and stimulus artifacts and electrode positioning (24).

Many authors and researchers alike, attribute certain therapeutic benefits from the joint crack associated with SMT. Observations such as a gain in both passive and active ranges of movement of the manipulated joint, in all ranges of motion (9), a temporary electrical silence (3), a sense of hypotonia (25), a decrease in pain (26), cellular

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biological effects (27) and a restoration of joint play (10) are some of the effects attributed to the audible release. However, these are observations only and have not been subjected to the rigours of scientific scrutiny. Many well designed and controlled trials have attempted to compare SMT with an audible release, to either mobilisation or a sham manipulation (28-31). In these comparative studies the forces employed during the mobilisation procedure or the sham manipulation were far less than those employed during the SMT procedures, resulting in an audible release. Although the manipulative procedures used in these studies were invariably accompanied by an audible release, it is impossible to attribute the beneficial effects of the SMT solely to the joint cracking noise, due to great variations in the forces applied for both interventions.

The majority of the empirical evidence relating to the therapeutic effects of the audible release has, in the main, been founded on earlier research relating to joint cracking from manipulation of the (MCP) joints (7,14,17,32-34) and other joints (34,35). Sandoz (9) states that after the joint crack there is a gain in the range of movement which is not limited to the direction of manipulation. Mierau et al (14) compared manipulation with mobilisation of the MCP joints and found that manipulation, accompanied by a cracking sound, resulted in a significant increase in passive joint flexion, when compared to mobilisation. The exact mechanism responsible for the audible release has as yet not been confirmed but there is some research which suggests that the cracking sound produced by manipulation of the MCP joints is due to, or associated with, cavitation within the intra-articular synovial fluid (17,32,33). To facilitate the cavitation process requires an increase in the joint volume via distension of the capsular ligaments and separation of the opposing facets, leading to a decrease in the joint fluid pressure. At sufficiently low pressures vaporisation and gas liberation from the synovial fluid occurs resulting in the rapid formation and collapse of a gas bubble.

There is little to no scientific evidence to suggest that the cavitation process thought to be responsible for the joint cracking sound in the MCP joints is the same process responsible for the audible release produced during SMT. The techniques employed in both manipulative processes differ significantly. Most of the research on MCP joint cracking employs graduated long axis traction, a non-physiological movement, to distract the joint (14,17), whereas SMT utilises a sudden thrust at the normal end range of joint motion (5).

Meal and Scott (34) make mention of some observations made by Mennell (36), relating to manipulation under anaesthesia with joint cracking sounds, and extrapolate his findings to encompass SMT. Mennell observed that the therapeutic effects of manipulation are maintained

when short lasting anaesthesia is used but are lost when longer lasting anaesthesia is employed. Unfortunately, Mennell's observations were related to manipulation of the shoulder and it would seem untenable to compare either the manipulative techniques or the treated conditions with those relating to apophyseal joint dysfunction. Cyriax (35) also draws similar comparisons for manipulation of the knee and SMT, describing the "click" associated with the reduction of a displaced meniscus in the knee and its immediate effect on an increase of joint range of motion. The release of a trapped meniscoid has been postulated as a mechanism for the therapeutic effect of SMT (6,37). However, it is highly unlikely that the clicking noises produced from a torn or degenerative knee meniscus are generated by the same mechanism responsible for the audible release accompanying SMT. Vibration arthrography studies (38,39), including sound spectrum analysis confirm that the median frequency produced by meniscal clicking noises is 108 Hz while cracking sounds produced by SMT applied to the cervical spine had a median frequency of 215 Hz (40). Furthermore, there is a refractory period of approximately 20 minutes after a cracking sound is produced by SMT (9) and during that time it is not possible to obtain a further audible release, whereas meniscal clicks can be elicited at will.

Other researchers (34,41,42) have attempted to compare the sound profiles produced by manipulation of the MCP joints with those associated with SMT and have concluded that both sounds have similar wave forms and spectra, suggesting that they are from a common origin. However, the reliability and validity of these studies is questionable due to study design and the possibility of methodological flaws (43). There are a number of factors which make any frequency comparison difficult. The cracking sound is not a pure tone but is composed of a number of different frequencies, which would be affected by the differences in the shape, size and thickness of overlying soft tissue between the two joints. Attempts to compare joint cracks recorded by microphones and by accelerometers has also been shown to be unreliable (39). Both accelerometers and microphones are subject to signal contamination from a number of sources, including faulty mounting procedures, extraneous noise and signal processing methods. Other problems arise when researchers attempt to compare different studies due to differences in methods of recording and processing of the captured joint crack signals. Finally, some of the studies (34,41) do not adequately describe the materials and methods employed for recording the joint cracks, leaving open to question the validity and reliability of their conclusions.

Furthermore, from clinical experience (22) it is not uncommon to elicit an audible release during the set-up phase of the HVT. During the set-up only minimal joint distraction occurs, and there is no thrust and therefore

minimal separation of the joint surfaces. Based on the original findings of Unsworth et al (17) this type of joint crack does not fit their model of cavitation, nor does it fit a later theory by Brodeur (18), incorporating the snapping back of the distended capsular ligaments. While some clinicians regard this cracking noise as insignificant (44), frequency analysis of this sound showed no statistical significance, when compared to joint cracks produced from manipulation, suggesting both noises may have a common origin (40).

It is also interesting to note the observations of McFadden and Taylor (45) which also cast doubt on the cavitation model to explain the audible release during SMT. These researchers conducted a study on twelve cadaver lumbosacral spines in an attempt to gap the zygapophyseal joints in axial rotation, flexion and extension, using both manual and mechanical forces. Digital palpation, CT Scanning and visual inspection of the joints was used to determine any separation of the facet surfaces. Only those joints which were unstable due to pathological changes, ie. fractures, torn capsules, severe arthritic changes, showed any appreciable gapping. What the authors did observe, in all specimens, was the adaptation of the joints to axial rotation by the compliance of the articular cartilages and the movement of fat pads in and out of the joint capsule. This finding tends to contradict the cavitation model of the MCP joints. The movements of the fat pads in and out of the joint would tend to keep the internal joint volume relatively constant, thus preventing a decrease in the synovial fluid pressure and subsequent vaporisation of the dissolved gases necessary for cavitation to occur. However, the forces used in this study were applied slowly, unlike the rapidly applied forces utilised in SMT, and also may not have been sufficient to induce gapping.

Although not directly related to the therapeutic benefits of the audible release some research indicates that after one SMT procedure, resulting in an audible release, subsequent manipulations require less force to obtain a further release (7,46) and an increase in tissue compliance around the manipulated joint (46).

Solinger (47) has proposed a novel theory on the mechanism responsible for the therapeutic benefits of SMT and which in principle may incorporate the audible release. This theory is based on the frequencies of vertebral oscillations, caused by the forces applied during SMT. Solinger hypothesises that specific frequencies could stimulate the nervous system giving rise to specific physiological effects, and that these may turn out to be important aspects of the beneficial effects of SMT. Although this research focused on the gross vertebral oscillation frequencies produced by the thrust component of SMT, the audible release also results in vertebral

oscillations, with their own unique frequency spectra. Therefore, the possibility exists that the frequencies produced by the audible release, may in themselves, initiate specific neurological or biological effects.

Possibly the greatest therapeutic benefit of the audible release may not be physiological in nature but rather psychological. The joint crack may have a powerful placebo effect on both the patient and practitioner (9,44,48) and from clinical experience it would appear that neither are satisfied until an audible release has been achieved. Fisk (49) states "the dramatic click may have suggestive value. Oh! You have put something back Doc". Cooperstein (44) relates a story of attending a seminar at which the instructor repeatedly manipulated a participant's neck, in order to elicit an audible release. Having failed to achieve his goal on six occasions, he declared despite the production of a cracking sound the correction had taken place. "The patient knew better". It is not unreasonable to assume that if the patient expects to hear a cracking sound during SMT, and interprets this sound as a sign of a successful manipulation, when his expectation is not fulfilled then it may have a negative effect on the clinical outcome. Conversely, if an audible release is achieved, particularly with reinforcement from the practitioner, then a powerful placebo effect may ensue.

CONCLUSION

Currently there is little scientific evidence to support any therapeutic benefit derived from the audible release and in fact, it appears that the available evidence tends to refute many of the alleged beneficial effects. Given that many practitioners and patients alike place an importance on this aspect of SMT further research is required in order to fully investigate this phenomenon.

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