Published in : Joint Bone Spine (2018), vol. 85, n°2, pp. 239–242
DOI: https://doi.org/10.1016/j.jbspin.2017.04.006
Status : Postprint (Author's version)

BELIEFS IN THE POPULATION ABOUT CRACKING SOUNDS PRODUCED DURING SPINAL MANIPULATION

Christophe Demoulin[a,b], Damien Baeri[b], Geoffrey Toussaint[b], Barbara Cagnie[c], Axel Beernaert[c], Jean-Francois Kaux[a,b], Marc Vanderthommen[a,b]

[a] *Département des sciences de la motricité, université de Liège, 4000 Liège, Belgium*
[b] *Service de médecine de l'appareil locomoteur, clinique du dos, CHU de Liège, 4000 Liège, Belgium*
[c] *Rehabilitation Sciences and Physiotherapy Department, université de Gand, 9000 Gand, Belgium*

KEYWORDS : Pain ; Spine Manipulation ; Beliefs ; Representation Manual therapy Osteopathy

ABSTRACT :

Objectives: To examine beliefs about cracking sounds heard during high-velocity low-amplitude (HVLA) thrust spinal manipulation in individuals with and without personal experience of this technique.

Methods: We included 100 individuals. Among them, 60 had no history of spinal manipulation, including 40 who were asymptomatic With or without a past history of spinal pain and 20 who had nonspecific spinal pain. The remaining 40 patients had a history of spinal manipulation; among them, 20 were asymptomatic and 20 had spinal pain. Participants attended a one-on-one interview during which they completed a questionnaire about their history of spinal manipulation and their beliefs regarding sounds heard during spinal manipulation.

Results: Mean age was 43.5 ± 15.4 years. The sounds were ascribed to vertebral repositioning by 49% of participants and to friction between two vertebras by 23% of participants; only 9% of participants correctly ascribed the sound to the formation of a gas bubble in the joint. The sound was mistakenly considered to indicate successful spinal manipulation by 40% of participants. No differences in beliefs were found between the groups with and without a history of spinal manipulation.

Conclusions: Certain beliefs have documented adverse effects. This study showed a high prevalence of unfounded beliefs regarding spinal manipulation. These beliefs deserve greater attention from healthcare providers, particularly those who practice spinal manipulation.

Published in : Joint Bone Spine (2018), vol. 85, n°2, pp. 239–242
DOI: https://doi.org/10.1016/j.jbspin.2017.04.006
Status : Postprint (Author's version)

1. Introduction

Spinal manipulation using the high-velocity low-amplitude (HVLA) thrust technique is applied passively to a joint complex at the end point of the available range of motion, while keeping it within its anatomical limit [1]. HVLA spinal manipulation is among the earliest manual techniques [2]. Thus, in 400 BCE, Hippocrates described combinations of spinal traction and manipulation [3]. Spinal manipulation then continued to be used over the centuries, gaining widespread acceptance in the 19th century before undergoing considerable development in the 20th century with the introduction of osteopathy, chiropractic, manual medicine, and orthopedic manipulative treatments [3]. Spinal manipulation remains widely used today [4,5]. A 2007 post hoc analysis of prospective data showed that over one-quarter of patients who visited primary-care physicians for low-back pain were treated with spinal manipulation within the next year [6].

Many published studies have evaluated the indications, contraindications, risks, and effects of spinal manipulation [7-12]. Another focus of considerable attention has been the cracking sound heard during joint manipulation; however, most studies concerned the metacarpophalangeal joints [13], which are readily accessible and often emit cracking sounds [14]. These sounds are now ascribed to cavitation [15], which is the formation of vapor bubbles in a fluid when a mechanical effect induces a pressure drop. There is no rise in temperature. During traction or HVLA manipulation, the joint surfaces are separated from each other, causing an increase in volume and, consequently, a drop in pressure [15,16]. Beyond a pressure threshold, chemical changes convert part of the synovial fluid to gas, producing a cracking sound. A magnetic resonance imaging study has established that the cracking sound produced by applying traction to a metacarpophalangeal joint is due to the formation, and not to the collapse, of a gas bubble [17]. This bubble is unstable and collapses promptly after the maneuver [17].

Despite this scientific evidence, spinal manipulation and the cracking sound it often produces remain largely enigmatic to the general population. Beliefs concerning these sounds have only rarely been studied [18]. Nevertheless, erroneous beliefs about sounds during spinal manipulation may suggest the existence of other erroneous beliefs (e.g., that the back is fragile) potentially associated with harmful effects such as increased fear and catastrophizing and diminished self-efficacy, which are viewed as risk factors for progression to and/or perpetuation of chronicity [19].

The primary objective of this study was to evaluate the beliefs of individuals in the general population regarding the cracking sound usually heard during spinal manipulation. The secondary objective was to determine whether these beliefs differed between individuals with and without a history of spinal manipulation.

Published in : Joint Bone Spine (2018), vol. 85, n°2, pp. 239–242
DOI: https://doi.org/10.1016/j.jbspin.2017.04.006
Status : Postprint (Author's version)

2. Methods

The study protocol was approved by the institutional review board of the University Hospital in Liège, Belgium.

2.1. RECRUITMENT OF PARTICIPANTS

Volunteers were recruited among personal connections of the investigators, via social networks and advertisements, and in hospitals. The goal was to enroll 60 individuals with and 40 without a history of spinal manipulation. The participants with no history of spinal manipulation (SM-group) either had spinal pain at the time of the study or were asymptomatic with, or without a history of physician visits for spinal pain. The participants with a history of spinal manipulation (SM+ group) either had spinal pain at the time of the study, or were asymptomatic with a history of physician visits for spinal pain. The secondary objective of the study was to compare the SM- and SM+ groups. Exclusion criteria for participants in both groups were age younger than 18 years, difficulty communicating in French, training directly related to spinal manipulation (e.g., physical therapy, osteopathy, or medicine), and spinal pain due to a specific cause (infection, inflammation, tumor, or trauma).

The participants were informed about the study, then interviewed during a face-to-face meeting with the investigator. A digital audio recorder was activated during the interview. Open-ended questions were asked to collect data in the following areas:

- demographics (age, educational attainment, and occupation);
- history of spinal pain, current spinal pain;
- experience with spinal manipulation;
- beliefs regarding the cracking sounds heard during spinal manipulation.

Participants with current spinal pain answered questions about the duration and site of the pain and assessed pain intensity on a 0-10 numerical scale; depending on the site of the pain, they completed either the Neck Disability Index (NDI) (0-50 points) [20] or the *Échelle d'Incapacité Fonctionnelle pour l'Évaluation des Lombalgies* (EIFEL) questionnaire for low-back pain (i.e. the French version of the Roland-Morris Disability Questionnaire) [21]. Participants were asked whether they had been treated with spinal manipulation, how often, for which spinal site, and by what type of professional. For these questions and those on beliefs, spinal manipulation was defined as a rapid low-amplitude thrust often responsible for a cracking sound. Beliefs about the origin of the cracking sound were assessed by asking the following question: "What is the sound usually heard during spinal manipulation (where does it come from)?" For beliefs about the meaning of the sound, the question was "Does the sound indicate successful spinal manipulation (and does absence of the sound mean the spinal manipulation was unsuccessful)?".

Published in : Joint Bone Spine (2018), vol. 85, n°2, pp. 239–242
DOI: https://doi.org/10.1016/j.jbspin.2017.04.006
Status : Postprint (Author's version)

2.2. STATISTICAL ANALYSIS

Quantitative variables were described as mean ± SD when the Shapiro-Wilk test indicated normal distribution and as median (interquartile range) otherwise. Qualitative variables were described as *n* (%). Quantitative variables were compared between the SM- and SM+ groups by applying the *t* test. For qualitative variables, between-group comparisons were conducted with the chi-squared test if the underlying assumptions were met and Fisher's exact test otherwise. *P* values < 0.05 were taken to indicate significant differences. All statistical analyses were performed on Statistica software (StatSoft, Tulsa, OK, USA).

3. Results

3.1. DESCRIPTIVE DATA

Table 1 reports the main features of the SM- and SM+ groups. There were no significant differences for the sex ratio, mean age, educational attainment, or occupation (all *P* values > 0.05).

Of the 100 participants, 40 reported spinal pain at the time of the study. Mean pain duration was 13.8 ± 11.2 years and mean duration of disability was 2.3 ± 6.3 years. Mean pain intensity on the 0-10 numerical scale was 6.0 ± 1.9. The site of the pain was the lumbar spine in 80% of cases, with a mean EIFEL score of 10.9 ± 5.7. The remaining patients had neck pain with a mean NDI of 20.7 ± 10.5.

Among the 40 participants in the SM+ group, 87.5% had received SM by an osteopath, 35% by a physical therapist, 10% by a physician, and 10% by a chiropractor. Nine participants had received SM only once during their life (versus two to over ten times for the other 31 participants).

***Table 1**. Main features of the participants with and without a history of spinal manipulation (SM+ and SM−groups).*

	Total ***n*=100**	**SM−** ***n*=60**	**SM+** ***n*=40**	***P* value**
Sex, *n* (%)				0.46
Males	43 (43.0)	24 (40.0)	19 (48.0)	
Females	57 (57.0)	36 (60.0)	21 (52.0)	
Age (years), mean±SD	43.5±15.4	42±15.9	45.8±14.4	0.22
Occupational status, *n* (%)				0.45
Working	63 (63.0)	36 (60.0)	27 (67.0)	
Not working	37 (37.0)	24 (40.0)	13 (33.0)	
Educational attainment, *n* (%)				0.44
University education	24 (24.0)	16 (27.0)	8 (20.0)	
Primary, secondary, or vocational	76 (76.0)	44 (73.0)	32 (80.0)	

Published in : Joint Bone Spine (2018), vol. 85, n°2, pp. 239–242
DOI: https://doi.org/10.1016/j.jbspin.2017.04.006
Status : Postprint (Author's version)

3.2. BELIEFS ABOUT SPINAL MANIPULATION

Table 2 lists the answers to the questions about beliefs. Regarding the origin of the cracking sound, 50.0% of SM+ participants and 48.3% of SM- participants ascribed the sound to repositioning of the vertebras. The second most common belief was friction between vertebras (22.5% in the SM+ group and 23.3% in the SM- group). Of the 100 participants, only 9 (5/60 in the SM- group and 4/40 in the SM+ group) correctly indicated that the sound was produced by a gas bubble within the joint; 5 of these individuals had academic degrees. The SM- and SM+ groups were not significantly different regarding beliefs about the origin of the sound (P >0.8).

Overall, 60% of participants (58.3% in the SM- group and 62.5% of the SM+ group) believed the cracking sound was not proof of a successful manipulation. Replies to the question about the meaning of the sound were not significantly different between the two groups.

***Table 2**. Beliefs about the origin of cracking sounds during spinal manipulation in the groups with and without a history of spinal manipulation (SM+ and SM- groups).*

	Total ***n*=100**	**SM−** ***n*=60**	**SM+** ***n*=40**
Number (%) of participants with the reply	100 (100.0)	60 (100.0)	40 (100.0)
The vertebras return to their normal position	49 (49.0)	29 (48.3)	20 (50.0)
The vertebras rub against each other	23 (23.0)	14 (23.3)	9 (22.5)
A gas bubble forms in the joint	9 (9.0)	5 (8.3)	4 (10.0)
A ligament is released	5 (5.0)	2 (3.3)	3 (7.5)
I don't know	3 (3.0)	1 (1.7)	2 (5)
The disks return to their normal position	2 (2.0)	2 (3.3)	0 (0.0)
The maneuver distracts the vertebras	2 (2.0)	1 (1.7)	1 (2.5)
A nerve is released	2 (2.0)	1 (1.7)	1 (2.5)
The disk and vertebra rub against each other	1 (1.0)	1 (1.7)	0 (0.0)
The cartilage returns to its normal position	1 (1.0)	1 (1.7)	0 (0.0)
The cartilage between the bones changes shape	1 (1.0)	1 (1.7)	0 (0.0)
The joint between the vertebras returns to its normal position	1 (1.0)	1 (1.7)	0 (0.0)
The cause is the calcium deposited between the vertebras	1 (1.0)	1 (1.7)	0 (0.0)

Published in : Joint Bone Spine (2018), vol. 85, n°2, pp. 239–242
DOI: https://doi.org/10.1016/j.jbspin.2017.04.006
Status : Postprint (Author's version)

4. Discussion

Several studies have assessed beliefs in the general population and among patients with low-back pain [22-25]. Few of them, however, focused specifically on spinal manipulation. We found that a large majority of individuals had mistaken beliefs about the origin of the cracking sound usually heard during spinal manipulation. Beliefs regarding the sound were not significantly different between participants with and without a history of spinal manipulation.

The cracking sounds produced by joints have been well described in the scientific literature [17] and have probably been experienced at the metacarpophalangeal joints by most individuals. Nevertheless, in keeping with an earlier study [18], we found that most individuals had misconceptions about the origin of cracking sounds heard during SM. Most of these misconceptions can be considered harmful, as they assume events (i.e., an anatomic structure is no longer in its normal position) suggesting both that the back is fragile and that professional help is needed to restore normal alignment. These two beliefs may have unwanted consequences such as avoidance behaviors [26] (viewed as possibly participating in progression to and/or perpetuation of chronicity [24]) and alterations in the perception of self-efficacy (viewed as a key factor [27] whose beneficial effects include enhancement of treatment efficacy [28]). Patients seem eager to receive information about spinal manipulation [18] and should therefore be given appropriate explanations.

Our results suggesting that the spine is perceived as fragile and unstable agree with those obtained over 30 years ago in 96 patients with spinal pain, among whom 53% ascribed the pain to the displacement of a muscle, disk, or joint [29]. These potentially harmful beliefs may stem from a variety of sources [30]. Information brochures and media campaigns have been used in some countries [31,32], but their beneficial effects faded over time [33]. Thus, discussions between the clinician and patient are crucial to identify and correct harmful beliefs [30].

Our finding that most participants in both the SM- and SM+ groups had erroneous beliefs regarding cracking sounds indicates that the professionals who perform spinal manipulation fail to provide their patients with clear and appropriate explanations. Patients should be told that spinal manipulation does not seek to reposition a structure and that the cracking sound merely reflects a physical cavitation process. The beneficial effects of spinal manipulation may be mediated by changes in the central nervous system [8], which probably include pain inhibition and modifications in moto neuron pool activity. However, nonspecific mechanisms related to the placebo effect and patient expectations may be involved also [8].

In keeping with the results of an earlier study [18], 60% of our participants correctly believed that a cracking sound was not proof of a successful maneuver. Production of a cracking sound does not seem significantly associated with greater efficacy [13,34-36]. Moreoever, the sound may occur at several levels or on the side that is not being manipulated [37,38]. Although the sound is not necessary, it may have a beneficial psychological effect, since many patients believe it contributes to the efficacy of the treatment [39,40]. Absence of a sound may have a nocebo effect by suggesting to the patient that the maneuver failed. The importance ascribed to the sound by the patients

Published in : Joint Bone Spine (2018), vol. 85, n°2, pp. 239–242
DOI: https://doi.org/10.1016/j.jbspin.2017.04.006
Status : Postprint (Author's version)

probably reflects the belief that spinal manipulation causes structural modifications and may, therefore, constitute additional evidence of a failure to provide appropriate information.

4.1. STUDY LIMITATIONS

The sample size of 100 participants is substantial, and the participants had a variety of profiles in terms of past and current symptoms and of experience with spinal manipulation. Nevertheless, a larger sample would be needed to fully represent the general population. Mailing the questionnaires would have allowed the inclusion of a larger number of participants. We chose to administer the questionnaires during a one-on-one interview to ensure that the participants would not seek information from outside sources (e.g., the Internet, or other people) and to explain questions to which the replies were unclear.

The interviewer started each interview by defining spinal manipulation. Some participants may, however, have misunderstood the definition (considering also other manual techniques). Assessing the specific beliefs of individuals who are capable of inducing spinal cracking sounds on their own would be of interest. Questions to determine whether participants make a connection between cracking sounds from the fingers and those from the spine would also be helpful. Furthermore, our study cannot determine whether the erroneous beliefs by most participants in the SM+ group were related to inappropriate information from the professionals providing spinal manipulation or reflected an inability to understand or remember explanations.

Finally, in the SM+ group, 87.5% of participants had been treated by an osteopath. We were therefore unable to compare beliefs according to the type of professional performing spinal manipulation. However, this finding reflects the fact that, in French-speaking Belgium (where the study was conducted), spinal manipulation is performed far more often by osteopaths than by other healthcare professionals (physical therapists, manual therapists, physicians, and chiropractors).

In conclusion, most participants had erroneous and potentially harmful beliefs about the cracking sound usually produced during spinal manipulation. These beliefs were prevalent even among individuals who had personal experience with spinal manipulation. Therapists performing spinal manipulation should direct greater attention to their patients' beliefs and to explaining spinal manipulation objectives.

Acknowledgments

We thank all the participants in this study, Ms. Depaifve for formatting and revising the article and Prof. G. Kawchuk for his advice.

Published in : Joint Bone Spine (2018), vol. 85, n°2, pp. 239–242
DOI: https://doi.org/10.1016/j.jbspin.2017.04.006
Status : Postprint (Author's version)

References

[1] Bialosky JE, Bishop MD, Price DD, et al. The mechanisms of manual therapy in the treatment of musculoskeletal pain: a comprehensive model. Man Ther 2009;14:531–8.

[2] LaBan MM, Taylor RS. Manipulation: an objective analysis of the literature. Orthop Clin North Am 1992;23:451–9.

[3] Pettman E. A history of manipulative therapy. JMMT 2007;15:165–74.

[4] Gross A, Miller J, D'Sylva J, et al. Manipulation or mobilisation for neck pain: a Cochrane review. Man Ther 2010;15:315–33.

[5] Rubinstein SM, van Middelkoop M, Assendelft WJ, et al. Spinal manipulative therapy for chronic low-back pain: an update of a Cochrane review. Spine 2011;36:E825–46.

[6] Chenot JF, Becker A, Leonhardt C, et al. Use of complementary alternative medicine for low back pain consulting in general practice: a cohort study. BMC Complement Altern Med 2007;7:42.

[7] Vautravers P, Isner-Horobeti ME, Maigne JY. Manipulations vertébrales - ostéopathie. Évidence/ignorances. Rev Rhum 2009;76:405–9.

[8] Bialosky JE, George SZ, Bishop MD. How spinal manipulative therapy works: why ask why? JOSPT 2008;38:293–5.

[9] Gibbons P, Tehan P. HVLA thrust techniques: what are the risks? Int J Osteopathic Med 2006;9:4–12.

[10] Gibbons P, Tehan P. Spinal manipulation: indications, risks and benefits. J Bodywork Mov Ther 2001;5:110–9.

[11] Puentedura EJ, March J, Anders J, et al. Safety of cervical spine manipulation: are adverse events preventable and are manipulations being performed appropriately? A review of 134 case reports. JMMT 2012;20:66–74.

[12] Maigne JY, Vautravers P. Mechanism of action of spinal manipulative therapy. Joint Bone Spine 2003;70:336–41.

[13] Sweetman BJ. Clicks and clunks with low back pain; what do they mean? A literature review. Int Musculoskelet Med 2009;31:25–8.

[14] Roston JB, Haines RW. Cracking in the metacarpo-phalangeal joint. J Anat 1947;81:165–73.

[15] Watson P, Mollan RA. Cineradiography of a cracking joint. Br J Radiol 1990;63:145–7.

[16] Cramer GD, Ross K, Raju PK, et al. Quantification of cavitation and gapping of lumbar zygapophyseal joints during spinal manipulative therapy. JMPT 2012;35:614–21.

[17] Kawchuk GN, Fryer J, Jaremko JL, et al. Real-time visualization of joint cavitation. Plos One 2015;10:e0119470.

[18] Gouin M, Dey M. Étude sur la perception du patient concernant le bruit articulaire lors d'une manipulation haute vélocité basse amplitude. Rev Osteopath 2014;13:29–37.

[19] Demoulin C, Roussel N, Marty M, et al. The maladaptive beliefs of patients with low back pain. A narrative review. Rev Med Liege 2016;71:40–6.

[20] Wlodyka-Demaille S, Poiraudeau S, Catanzariti JF, et al. French translation and validation of 3 functional disability scales for neck pain. Arch Phys Med Rehabil 2002;83:376–82.

[21] Coste J, Le Parc JM, Berge E, et al. French validation of a disability rating scale for the evaluation of low back pain (EIFEL questionnaire). Rev Rhum Ed Fr 1993;60:335–41.

[22] Foster NE, Bishop A, Thomas E, et al. Illness perceptions of low back pain patients in primary care: what are they, do they change and are they associated with outcome? Pain 2008;136:177–87.

[23] Pincus T, Vogel S, Burton AK, et al. Fear avoidance and prognosis in back pain: a systematic review and synthesis of current evidence. Arthritis Rheum 2006;54:3999–4010.

Published in : Joint Bone Spine (2018), vol. 85, n°2, pp. 239–242
DOI: https://doi.org/10.1016/j.jbspin.2017.04.006
Status : Postprint (Author's version)

[24] Rainville J, Smeets RJ, Bendix T, et al. Fear-avoidance beliefs and pain avoidance in low back pain–translating research into clinical practice. Spine J 2011;11:895–903.

[25] Ng SK, Cicuttini FM, Wang Y, et al. Negative beliefs about low back pain are associated with persistent high intensity low back pain. Psychol Health Med 2016;12:1–10.

[26] Pincus T, Smeets RJ, Simmonds MJ, et al. The fear avoidance model disentangled: improving the clinical utility of the fear avoidance model. Clin J Pain 2010;26:739–46.

[27] Woby SR, Urmston M, Watson PJ. Self-efficacy mediates the relation between pain-related fear and outcome in chronic low back pain patients. Eur J Pain 2007;11:711–8.

[28] Keedy NH, Keffala VJ, Altmaier EM, et al. Health locus of control and self-efficacy predict back pain rehabilitation outcomes. Iowa Orthop J 2014;34:158–65.

[29] Zusman M. Spinal pain patients' beliefs about pain and physiotherapy. Aust J Physiother 1984;30:145–51.

[30] Darlow B, Dowell A, Baxter GD, et al. The enduring impact of what clinicians say to people with low back pain. Ann Fam Med 2013;11:527–34.

[31] Buchbinder R. Self-management education en masse: effectiveness of the back pain: Don't Take It Lying Down mass media campaign. Med J Aust 2008;189:S29–32.

[32] Gross DP, Russell AS, Ferrari R, et al. Evaluation of a Canadian back pain mass media campaign. Spine 2010;35:906–13.

[33] Buchbinder R, Jolley D. Population based intervention to change back pain beliefs: three year follow up population survey. BMJ 2004;328:321.

[34] Flynn TW, Childs JD, Fritz JM. The audible pop from high-velocity thrust manipulation and outcome in individuals with low back pain. JMPT 2006;29:40–5.

[35] Flynn TW, Fritz JM, Wainner RS, et al. The audible pop is not necessary for successful spinal high-velocity thrust manipulation in individuals with low back pain. Arch Phys Med Rehabil 2003;84:1057–60.

[36] Bialosky JE, Bishop MD, Robinson ME, George SZ. The relationship of the audible pop to hypoalgesia associated with high-velocity, low-amplitude thrust manipulation: a secondary analysis of an experimental study in pain-free participants. JMPT 2010;33:117–24.

[37] Dunning J, Mourad F, Barbero M, et al. Bilateral and multiple cavitation sounds during upper cervical thrust manipulation. BMC Musculoskelet Disord 2013;14:24.

[38] Ross JK, Bereznick DE, McGill SM. Determining cavitation location during lumbar and thoracic spinal manipulation: is spinal manipulation accurate and specific? Spine 2004;29:1452–7.

[39] Bakker M, Miller J. Does an audible release improve the outcome of a chiropractic adjustment? J Can Chiropr Assoc 2004;48:237–9.

[40] Reggars JW. The therapeutic benefit of the audible release associated with spinal manipulative therapy. A critical review of the literature. Australas Chiropr Osteopathy 1998;7:80–5.