Author's response to reviews

Title: Restoration of disk height through non-invasive spinal decompression is associated with decreased discogenic low back pain: a retrospective cohort study

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Author's response to reviews: see over
Dear Dr. Norton,

First, we would sincerely like to thank you for accepting in principle for publication in your Journal the manuscript #6374951963150235 entitled:

“Restoration of disk height through non-surgical spinal decompression is associated with decreased discogenic low back pain: a retrospective cohort study

Given the enormous health burden of low back pain, we still believe this to be valuable information for the readership of BMC Musculoskeletal Disorders. Pursuant to the requests made by the BMC Series Editorial Production Team, we have modified our manuscript and accompanying tables and figures to conform to journal style.

Specifically, we have updated contact details, ensured that the Abstract in the manuscript matches exactly what is in the submission system, indicated that all authors read and approved the final manuscript, and included the tables within the text file of the manuscript following the references. We made the minor modifications requested such as including the country in all affiliation details, removing the line numbering, removing figure details from the figure image file, and editing for general typography.

In previous manuscripts we made an acknowledgement of an advisor to the research, Dr. Frank Florio; however, he has requested to be removed from the acknowledgements section because he deems it unnecessary for his inclusion since he was not an actual author of the paper.

All authors have read and approved the content and would be delighted if you would fully accept our findings worthy of being published in your prestigious journal. We greatly look forward to your response.

Sincerely,

Christian Apfel, MD, PhD

Christian Apfel, MD, PhD
Point-by-point response to assessors:

Reviewer: Leif Dahlberg

Major Compulsory Revisions

In this retrospective cohort study, subjects with low back pain were treated with motorized non-invasive spinal decompression. CT scans were made before and after treatment. The main outcomes were changes in pain as measured on a verbal rating scale from 0 to 10 during a flexion-extension range of motion evaluation and changes in disc height as measured on CT scans. In 30 patients, low back pain decreased and disc height increased so that height and reduction in pain were correlated.

1) How many patients were treated with the intervention during the inclusion period? Only the 30 patients that fulfilled the per protocol in- and exclusion criteria?
   - During the inclusion period, 103 patients were treated with the intervention at the Upper Valley Interventional Radiology facility in McAllen, Texas. CT scans taken within the appropriate time period were available for 36 patients, but in the end only 30 patients met all inclusion and exclusion criteria.
     - We have adjusted the opening sentence of the Results section to read: “During a two year period, Sept 19, 2005 to Aug 6, 2007, a total of 103 patients were treated with the intervention, but only 30 of those patients fulfilled the per protocol in- and exclusion criteria for the analysis.”

2) Line 138: Please define discogenic low back pain (how would one know that pain comes from the disc and not from other structures).
   Line 142: Please define bulging, protruding or herniated disc (size differences, mean, and SD.)
   Line 143: Please define degenerative disc disease (is there consensus to what criteria should be used in CT scans?).
   - In the vast majority of cases of LBP, a clear diagnosis cannot be made. In this retrospective study, diagnoses of LBP due to disc herniation and/or disc degeneration were made by radiologist WM pursuant to standard medical definitions and based on a medical history review and physical examination. While it seems commonsense that accurately pinpointing the origin of LBP could beneficially dictate a more tailored course of treatment, most available imaging techniques only provide one piece of the puzzle helping to arrive at a causal diagnosis.[1] Advanced imaging studies done by either CT or MRI identify features associated with spinal degeneration such as intervertebral disc degeneration, facet joint OA, spondylolysis, spondylolisthesis, spinal stenosis, and degenerative changes in paraspinal muscles.[2] Although CT demonstration of disc degeneration does not reliably indicate a source of LBP, its high resolution affords the
opportunity to measure small changes in the height of the disc, which was our goal in this retrospective study.[1]

- We have adjusted the Inclusion and Exclusion Criteria subheading in the Methods section discussing the relevant terms to read: “Patients and their medical records were eligible for inclusion if the patients were at least 18 years of age, consented for the 6-week treatment protocol, and presented with chronic low back pain of at least 3 out of 10 on a verbal rating scale and was due to either discogenic LBP or disc herniation according to a radiological diagnosis using standard medical definition. Discogenic LBP is most succinctly defined as a loss of lower back function with pain due to disc degeneration. Degenerative disk diseases often emerge when abnormal stresses cause the nucleus gelatinosus to unevenly distribute weight, the annular fibrosis and end plate incur structural damage, and a destructive inflammatory response is triggered to accelerate and perpetuate the degeneration of the disc.[3] A herniated disc (synonymous with a protruding or bulging disc) arises when the intervertebral disc degenerates and is weakened to such an extent that cartilage is pushed into the space containing the spinal cord or a nerve root to cause pain.[3]

All patients were treated at the Upper Valley Interventional Radiology facility (McAllen, Texas). Patient symptoms were evaluated by medical history review, physical examination, and a current CT scan (not older than 2 months prior to the start of treatment) to support a diagnosis of chronic discogenic LBP due to bulging, protruding or herniated intervertebral discs that may have been brought on by degenerative disc disease.”

3) The second main outcome was the change in the average disc height as measured by CT. Please provide information in the method part (not only in the discussion) regarding mean and SD for time points for CT scans.
- The data regarding mean and SD for time points when CT scans were performed were not collected. However, per inclusion/exclusion criteria for the study, “All CT scans analyzed were performed at least one hour after the subject got out of bed. The first CT scan was performed within two months before the initiation of the treatment, and the second CT scan at least one day after or immediately before the final treatment session.”

- Thus the Inclusion and Exclusion Criteria subheading in the Methods section now reads: “All CT scans analyzed were performed at least one hour after the subject got out of bed. The first CT scan was performed within two months before the initiation of the treatment, and the second CT scan at least one day after or immediately before the final treatment session.”

4) How many observers did the CT height measurements? How many times were the heights measured? Are there any between observer variations? Did the authors do any CT a couple of weeks after the treatment? This is certainly not a “blinded” study, so the accuracy of CT measurements is crucial.
• A single observer, author Dr. William Martin, performed the CT height measurements. The
investigator (WM) took and recorded only one height measurement for each of the intervertebral
discs under study per CT scan. We are acutely aware this is not a blinded study, so during the
process of data collection during the retrospective chart review Dr. Joseph Pergolizzi confirmed
the accuracy of the measurements but did not make any new measurements himself. The first CT
scan was performed within two months before the initiation of the treatment, and the second CT
scan at least one day after or immediately before the final treatment session. No CT scans were
performed several weeks after the treatment period ended.

- To clarify the questions raised, the Inclusion and Exclusion Criteria subheading in the
Methods section now reads: “Patients were only included if pre- and post-treatment CT
scans were performed on the same device, measurements taken by the same investigator
(WM), and data recorded on standard collection forms. One height measurement was
taken by WM for each of the intervertebral discs under study per CT scan. Accuracy of
data was confirmed by a second investigator (JP), but only one measurement was made
of each intervertebral disc per CT scan.”

5) In short, the protocol typically included 22 sessions of spinal decompression over a 6-week period
with 28-minute active treatment. Is this costly?
• The average market treatment cost is $80-150 per session, and the cost of the entire treatment
program ranges from $2,400-3,200.

6) One limitation of this study is the lack of a control group. In spite of the fact that the authors
objective was to demonstrate the correlation between increased disc height and reduction of pain, it
is still interesting to consider if placebo would be a possible explanation for the decrease in pain.
Specifically taking into account that the CT measurements seem not validated and that the
correlation (r=0.36, p=0.044) between the increase in disc and reduction in pain only showed a
r^2=0.13. Please discuss this issue in a paragraph.
• We acknowledge the lack of a control group as being a drawback to the study design, and
similarly agree that the placebo effect is something that should be touched upon in our
Discussion given that the correlation between increase in disc height and a resulting reduction in
pain is not overwhelmingly statistically significant.

- To expand on our discussion surrounding the lack of a control group and incorporate how
the placebo effect might have reared its ugly head in our retrospective study, we have
changed the Conclusion section to read: “One limitation of this study is the lack of a
control group. This is especially relevant for herniated discs, because of the significant
rate of spontaneous recovery.[4,5] A control group would have been absolutely
necessary if the primary objective was to establish a causal relationship proving that the
increase in disc height is due to the non-invasive spinal decompression; however, our
primary objective was rather to demonstrate the correlation between increased disc
height and reduction of pain. Thus, irrespective of a control group, this is the first study
that provides evidence of an association of an anatomical correlate, change in disc
height, with pain relief over time. Even so, it is possible the placebo effect may have
contributed to the perception of having decreased pain. Given that the correlation between the increase of disc height and the reduction of pain shows an \( r^2 = .13 \), while statistically significant, there is room for an argument suggesting that perhaps the placebo effect played a role in the positive outcome. Both limitations of the current retrospective study indicate the need for a randomized placebo controlled trial to establish a more concrete relationship between the anatomical disc changes attributed to the non-invasive spinal decompression intervention and the lessening of LBP.”

Reviewer: Michael Norberg

Interesting work, but it is on the pain that has been evaluated: I would have been interested in seeing a functional evaluation, as done with for ex. the Roland-Morris or Oswestry Questionnaire, since just pain evaluation is so limited, not covering other dimensions.

7) According to the methods, I would have liked to have seen a little description of the motorized device used in this paper, not just deference to an article difficult to gain access to if you want to know something about this device.

- To give the reader a clearer picture of the motorized device we have added several sentences describing the mechanical action of the intervention in addition to providing a reference to the operating guidelines of the DRX9000.
  - The Treatment protocol subheading under the Methods section has been expanded to include the following description of the intervention: “At the start of each session, the patient is fitted with adjustable lower and upper body harnesses and is lowered into the supine position. To initiate active treatment the machine then pulls the patient gently on the lower harness while the upper harness remains stationary, thus distracting the patient’s spine. A safety button can be pushed at any time by the patient to release all tension immediately.”

Discretionary Revisions

8) Line 141: more patient characteristics description: mobility, force, strength.

9) Line 164-167: consummation of pain medication; try to quantify, but also mention as to what sort of medication is used: traditional pain killers (paracetamol for ex.), morphine, tramadol, corticoids, anti-depression drugs.

10) Does the patient do other things? (e.g. active training; musculature massages…) or is it excluded? Do they see chiropractors, osteopaths etc.?

- While we acknowledge that additional patient characteristics discussing mobility and strength, a more detailed description of pain medication, and a list of concomitant treatments being utilized
would be beneficial, we did not collect this data during the retrospective chart review to incorporate these items into the manuscript.

11) Line 174: according to pain evaluation: how long time after the treatment period was the VAS evaluation done?
  o We clarified when the VRS was performed by adding the following to the sentence discussing the particular question asked of the patient: “During the routine physical examination performed by WM prior to beginning the non-invasive spinal decompression treatment session, at the first and final visits maximal pain was evaluated during a flexion-extension range of motion exam with the question “How strong is your pain on a scale of 0-10 with 0 being no pain and 10 as bad as it could be?”

Minor essential revisions

12) What about ethical committee? Taking into account the fact they are doing repeated CT-scans in healthy individuals. I don’t see any remark in the text.
  o This was a retrospective study that received a HIPAA waiver from Quorum IRB. The waiver permitted a retrospective medical chart review and re-access to CT scans that were ordered by Dr. WM as part of standard of care in his medical practice.
  o The Study design subheading under the Methods section now reads: “This is a retrospective cohort study of patients who underwent a 6-week treatment protocol of non-invasive spinal decompression via the DRX9000. A HIPAA (Health Insurance Portability and Accountability Act) waiver was obtained through Quorum IRB. This waiver permitted a review of medical records and access to CT scans ordered as part of standard of care.”

13) Line 138: There should be a remark concerning the age of the candidates, since the 30 patients had a medium age of 64 +/- 15 years (that says that they are older patients, so how with the young ones? What does this patient group do actively: are they still working (I have a doubt about that according to the patient age)?
  o To address the potential for age to play a role in the success of the intervention we added the following sentences to the Discussion: “Another reason for different inter-individual response rates could be the age of the patients. However, in sub-analyses (not described) we did not find a correlation between age and treatment success. With regards to the elderly cohort of patients analyzed in this retrospective study, it is possible that a younger patient population might respond differently to the non-surgical spinal decompression treatment given that they would generally have less disc degeneration, be more active, and have less co-morbidity than the elderly population studied here. Yet this is a hypothesis that remains to be tested in a prospective study investigating therapies to alleviate LBP in younger patients.”
14) There should be a remark according to the diagnosis: what do they name a herniation, since they write about chronic low back pain, not irradiating pain, and in that case the herniation of a disc doesn’t play any role, more degenerative disk disease. As they note, it would be very interesting to see what the long lasting effect of this treatment is (with a randomized trial).

- The 1st assessor similarly raised questions regarding the diagnoses and the definition of discogenic LBP, herniation, and degenerative disc disease.
- To address these concerns and to clarify we added the following to the Inclusion and exclusion criteria subheading of the Methods section: “Patients and their medical records were eligible for inclusion if the patients were at least 18 years of age, consented for the 6-week treatment protocol, and presented with chronic low back pain of at least 3 out of 10 on a verbal rating scale and was due to either discogenic LBP or disc herniation according to a radiological diagnosis using standard medical definition. Discogenic LBP is most succinctly defined as a loss of lower back function with pain due to disc degeneration. Degenerative disk diseases often emerge when abnormal stresses cause the nucleus gelatinosus to unevenly distribute weight, the annular fibrosis and end plate incur structural damage, and a destructive inflammatory response is triggered to accelerate and perpetuate the degeneration of the disc. A herniated disc (synonymous with a protruding or bulging disc) arises when the intervertebral disc degenerates and is weakened to such an extent that cartilage is pushed into the space containing the spinal cord or a nerve root to cause pain.”

15) Line 206: missing +/- (+/-15)…( +/-5)…( +/-19)
Line 207: missing +/- ()...
Line 209: +/- (6.8)
Line 210: +/- (7.6)
Line 211: +/- (2.2)...(2.3…)
Line 212: +/- (1.7)
- Thank you for pointing out the missing, as well as necessary, ± symbols.
  - Added the ± where required

16) Line 250: the success rate is not over 80%, but 76% (not bad at all, but not over…)
- You are correct in noting that our data indicates a 76% success rate, so we changed our discussion to reflect this exact rate.
  - The aforementioned sentence now states: “Using this standard, in this cohort study this intervention had a success rate of over 75% (pain decreased by more than 2 out of 11 in 23 out of 30 patients).”

17) Line 255: not only the muscle that would influence, but also other problems according to the population: static, degenerative disease.
• We appreciate you pointing out other confounds that could result in different inter-individual response rates and have added another sentence to mention some of these other factors.
  o In the Discussion section: “While we largely believe that varying muscle tones during non-surgical spinal decompression to be the main reason for different treatment effects, other reasons for variability could be differing stages and degrees of degenerative disc disease, an assortment of activity levels, and wide spectrum of concomitant treatments ranging from chiropractic interventions and pain medication cocktails.”

18) Table 1: same remark as below according the +/- for pain and disk height

Table 2: same remark as Table 1 for “first visit” and “last visit.”
  • Thank you for pointing out the missing as well as necessary ± symbols.
  o Added the ± where required

19) What is clinical significance of such as study? How much should the VAS go down to clearly signify a good result? We have results for surgery with a reduction of 2 on the VAS scale as significant?
  • According to Farrar et al’s study that aimed to determine the levels of change on standard pain scales that represent clinically important differences to patients, the best cut-off points for the absolute scales were absolute pain intensity difference of 2, pain relief of 2 (moderate), and sum of the pain intensity difference (SPID) of 2. We used this clinically significant change in absolute pain scores as our standard by which to evaluate the successful and incremental decrease in pain in conjunction with an increase in disc height.
  o The paragraph discussing the clinical significance of the study has been modified to now read: “Pain measurement relies first and foremost on patient report. Taking into account the subjectivity inherent in this process, it was noted that a cut-off point, or rather the change in pain score to detect a clinically important difference for the individual patient, was needed to identify responders and non-responders to analgesia. Farrar et al reported that on average a reduction in pain intensity of at least 2 points on the NRS serves as a clinically significant change.[6] Using this standard, in this cohort study this intervention had a success rate of over 75% (pain decreased by more than 2 out of 11 in 23 out of 30 patients). In our analysis, each millimeter of increase in disc height was associated with a pain relief of roughly 2 points on the scale, a clinically important difference according to the aforementioned report.”

20) Do the title and abstract accurately convey what has been found? Sort of. Perhaps the term “non-invasive spinal decompression” could leave someone in doubt, I didn’t understand in the beginning what it was about.
  • After reading your query, we did a pubmed.gov search for the term “non-invasive spinal decompression” as well as “non-surgical spinal decompression and found that the latter is the more widely used term and the one we will use in the title, abstract, and manuscript.
The title now reads: “Restoration of disk height through non-surgical spinal decompression is associated with decreased discogenic low back pain: a retrospective cohort study”

Reference List


6. Farrar JT, Young JP, Jr., LaMoreaux L, Werth JL, Poole RM: **Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale.** *Pain* 2001, 94: 149-158.