

## Peer Review File

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### Reviewer A

#### Overview

I appreciate the value of this case report which has several strengths including a unique patient presentation and treatment regimen, good figures, and a well-written discussion. I have only one major comment. The remainder are minor or to improve clarity.

#### Major comments

1. None

#### Minor comments

1. Throughout - use of the term “significance” or “significant” may be a bit problematic in this case. Do we have an idea of the minimal important change that is meaningful for markers of balance or postural improvement? Do we have a pre-post statistical comparison? When seeing the phrase “significance” readers may expect to see a P-value or at least, confidence intervals or some measure of precision. For different reasons, the phrase “dramatic” also may be not optimal. I think for both, if there’s evidence that the pre-post changes are clinically meaningful in the broader literature, then you should use a phrase such as “clinically meaningful” or some similar language. If this is unclear, you could state that there is an improvement, yet it’s unclear how meaningful the changes are.

Reply: Agreed. We took out all mentions using the word ‘dramatic.’ We also replaced all mentions of ‘significant/significance’ with ‘clinically significant’ We also discuss improvements were beyond the minimal detectable difference with 2 new references.

Changes in text: Now reads: “Importantly, there was a 102 cm reduction in COP total path length, which is well beyond the minimal detectable change of 10.5 cm (20) and 19.4 cm (21) for young and older adults in the eyes closed condition, respectively.”

New refs 20, 21:

20. Morrison R, Petit KM, Kuenze C, Moran RN, Covassin T. Preseason to Postseason Changes on the BTrackS Force Plate in a Sample of College Athletes. *J Sport Rehabil.* 2020 Jan 1;29(1):134-136.

21. Levy SS, Thralls KJ, Kviatkovsky SA. Validity and Reliability of a Portable Balance Tracking System, BTrackS, in Older Adults. *J Geriatr Phys Ther.* 2018 Apr/Jun;41(2):102-107.

2. Introduction – “There is a dearth of clinical evidence on the improvement in postural control for patients with ASD and previous surgical intervention.” – Maybe emphasize this

more, such as “However, to-date, limited research has examined... “ – consider citing a study that does this if you are aware of one.

Reply 1: We are not aware of any study that exists. This is why we would choose to keep the statement as reads.

Changes in text: None.

3. Case description – Please remove the exact date from the case history – this is for de-identification purposes. You can say June 2022 but I’d recommend avoiding stating the exact day.

Reply 3: Changes made.

Changes in text: “In June, 2022,...”

4. Case – You mention “The back pain was reported to be largely relieved and the headaches were reported to be rare”. Can you give any more objective data on this? E.g., what was her pre-post pain score, or disability score, or how frequent was she having headaches after follow-up? If you don’t have the data, it’s still acceptable since the focus is more on the balance and postural assessments, but if you do, you might as well report it.

Reply 4: We did not collect disability data, however, we added more details including 0-10 pain levels and frequency.

Changes in text: Now reads: “In June, 2022, a 69-year old female presented with gait and balance issues as well as back pains and headaches (2x/month). The patient underwent surgical stabilization for scoliosis at age 16 involving a single Harrington rod placed from T10 to L4. The pains were described to be in the mid and lower back, aggravated by walking and standing for too long and relieved by sitting or standing with her arms positioned behind her back. The pain started insidiously, approximately 3 years previous and were reported to range from 0-8/10 (0= no pain; 10= disabling pain) dependent on body position. She also reported having chronic digestive issues and headaches since age 4. Regarding her mobility, she reported feeling unsteady and lacked confidence to walk for extended periods due to balance issues which had been developing over the last 5 years. The patient did not report any previous falls and did not use a walking aid. The patient also reported having long standing stooped posture as well as diagnosed osteopenia. There was no familial scoliosis. The patient reported past physiotherapy that only provided short-term relief.”

5. You mention falls and I agree that this is an important consideration. It should be clear in the case if the patient used a cane or other walking aid or had any recent falls or trips/stumbles. In addition, it should be clear if there were falls during follow-up or treatment than before. Fall prevention is crucial in an elderly population and if you can add any more information about this, it would greatly strengthen your manuscript. If you don’t have the data or did not record falls in any systematic way, simply list that as a limitation.

Reply: There were no falls or walking aids used. We added some details to case description.

Changes in text: New lines 105-107: “Regarding her mobility, she reported feeling unsteady and lacked confidence to walk for extended periods due to balance issues which had been developing over the last 5 years. The patient did not report any previous falls and did not use a walking aid.”

Comments for clarity

2. Title - use of the acronym CBP may be confusing to some readers who are unaware what this means. For example, sometimes it means chronic back pain or community-based practice rather than Chiropractic Biophysics. You might have to shorten the title elsewhere to expand on this but I think that's possible.

Reply: Changed as indicated.

Changes in text: "A **Chiropractic Biophysics® case report**"

3. Abstract – use of "ASD" is not defined and this term often means "adjacent segment disease" in the post-surgical population so I think you need to clarify it's for adult spinal deformity.

Reply: Removed 'ASD'

Changes in text: "...**spinal deformity**..."

4. Abstract – the radiography showed "surgical hardware" – maybe list the spinal levels of hardware like T10-L4?

Reply: Added.

Changes in text: "... with long-standing spinal deformity including thoracic hyperkyphosis and a **T10-L4 Harrington rod** instrumentation for thoracolumbar scoliosis."

5. Key findings – "falling is a great risk for this cohort." – change cohort to "population"

Reply: Changed.

Changes in text: Now reads: "Future research is needed to explore non-surgical approaches to improving balance control in older persons with spinal deformity as falling is a great risk for this **population**."

6. Introduction – consider expanding "CARE" acronym in CARE checklist

Reply: Expanded.

Changes in text: "...**case report guidelines (CARE) checklist**"

7. Case – "headaches (2x/month)" – the 2x/month is a bit redundant, as a couple sentences later you clarify the headache frequency as two times per month

Reply: Removed second mention.

Changes in text: See text.

8. Case – can you note how long the patient had balance issues, back pain, and headaches for (months, years, etc.)? This is important to help understand how chronic her symptoms were.

For example, some authors might refer to this as "post-surgical persistent pain syndrome".

Reply: She did not suffer from PSPPS, the back pains started approximately 3 years previously, and balance issues were not to the point of major concern but was developing over the last 5 years.

Changes in text: "The pains were described to be in the mid and lower back, aggravated by walking and standing for too long and relieved by **sitting or** standing with her arms positioned

behind her back. The pain started insidiously, approximately 3 years previous and were reported to range from 0-8/10 (0= no pain; 10= disabling pain) dependent on body position. She also reported having chronic digestive issues and headaches since age 4. Regarding her mobility, she reported feeling unsteady and lacked confidence to walk for extended periods due to balance issues, this had been developing over the last 5 years. The patient did not report any previous falls and did not use a walking aid.”

9. Case – “The patient reported having scoliosis surgery when she was 16-years of age.” – Can you clarify the levels of surgery and mention Harrington rod here? You mention them later but it’s good to introduce this early. E.g., The patient underwent surgical stabilization for scoliosis at age 16 involving Harrington rods placed from T10 through L4. Also, please emphasize that it’s a single rod, as many patients have dual rods.

Reply: We changed.

Changes in text: Now reads: “The patient underwent surgical stabilization for scoliosis at age 16 involving a single Harrington rod placed from T10 to L4.”

10. Case – “digestive issue she attributes to her deteriorating back” – I’d remove the part that states “she attributes to her deteriorating back”. If this is not confirmed and it’s tangential to the main point of the manuscript, it seems distracting or unnecessary. Maybe just say “digestive issues” or clarify (irritable bowel syndrome, heartburn, bloating, etc.)

Reply: We took out.

Changes in text: “She also reported having chronic digestive issues.”

11. Case – “Physical assessment showed significant rigidity throughout the thoracolumbar spine.” – is this necessary to say? The patient has a surgical thoracolumbar fixation so there would not be expected mobility in the region.

Reply: We argue it is expected to report on findings from palpation.

Changes in text: None.

12. Case – Exam - Can you also mention if there were any neurological deficits in the lower extremities such as reflex/strength deficits?

Reply: Added.

Changes in text: “Muscle strength testing revealed lower limb weakness (4/5) on all lower limb muscle tests. Reflexes were normal.”

13. Case – “Many orthopedic tests could not be performed due to the inability to move the spine and limbs” – do you mean that passive movements were limited due to pain, or simply limited mobility? Otherwise it could be interpreted as the patient had so much weakness, she couldn’t lie down, roll over, or follow commands, etc.

Reply: Limited flexibility, not pain.

Changes in text: “Many orthopedic tests could not be performed due to the inability to move the spine and limbs due to inflexibility, and the straight leg raiser was limited bilaterally to 45° due to low back pain and hamstring tightness.”

14. Case – “FHP” – please define acronym or avoid it, it appears to only be used once

Reply: Agreed. Replaced with anterior head translation (AHT:...) – which we use later when describing results.

Changes in text: “...anterior head translation (AHT: 26.4mm),...”

15. Case – can you clarify the visit frequency (e.g., and how long visits typically lasted? And was any of this done at home? You mention “After 36 treatments over the first 3-months” but you could add a little more detail prior. This seems it would be 3 visits per week but maybe it was more in the beginning then tapered to less frequent?

Reply: 30 min./session, encouraged to do exercises at home, treatment was 3x/wk with no tapering.

Changes in text: “After 36 treatments (30 minutes/session) over the first 3 months (i.e. 3x/week),...” Also, added: “These exercises were encouraged to do daily as well as in-office.” – Referring to the 5 mirror image exercises (New line 148).

16. Case – “X-ray exam” consider rephrasing to “radiography” as x-rays are used in fluoroscopy and CT scans as well, so radiography is more specific to what you’re doing.

Reply: Agreed.

Changes in text: Replaced ‘X-ray exam’ to “Radiography...” in 2 locations.

17. Case – “FHP (26.4mm), and thoracic hyperkyphosis (64.7°).” – consider listing the normal range in brackets after the value in parentheses e.g., hyperkyphosis (64.7° [normal: X-X°]). You could do this for both values or neither (optional).

Reply: Since normal range is debatable, and since we are focusing on the balance improvements, less so on spine structural changes, we prefer to leave out normal ranges.

Changes in text: None.

18. Case – “hand-held percussion device” – can you list the brand/model? Would this qualify as “spinal manipulation”? if so, I’d use the term as the article will be more identifiable from a research standpoint. Also, was this done in preference rather than manual thrust or mobilization due to the patient’s osteopenia? Or was it done purely for mechanoreceptive/proprioceptive purposes.

Reply: We do not consider use of the percussion device as spinal manipulation. It was done for both of the reasons suggested.

Changes in text: “...using a hand-held percussion device (Impac Inc, Salem, OR, USA)...”

19. Case – please define “AHT” where it says “both reduced AHT” – I believe this is the only usage of the term.

Reply: We added the term at the first mention. It is now used in 2 locations.

Changes in text: “The sagittal profile spinal alignment (Fig. 1) shows a forward sagittal vertical axis from C2-S1 (SVA: 118.4mm), anterior head translation (AHT: 26.4mm),...” (New line 118).

20. Figure 1 – There are red and green lines shown on the film. Can you elaborate on what these indicate and how these were drawn, in the caption? Maybe also mention why the rod appears non-continuous in the image on the left. I understand the images are stitched together but I'm not sure why the spine would be contiguous but the rod wouldn't. Maybe some degree of rotation? Maybe there's some distortion? Optional to explain the latter comment.

Reply: Added description to Fig. 1. Regarding rod break on left picture – we attempted to correct this, but seems due to difference in size (zoom) of image between lateral lumbar and thoracic views.

Changes in text: To Fig. 1 : Added: “Red lines: posterior vertebral margins; Green line: Ideal path of posterior longitudinal ligament.”

21. Figure 2 – can you give a plain-language summary of how to interpret the changes in Figure 2? I get what it's showing, but how can you tell, at a glance, that there's improvement? E.g., less variability and improved centrality of the yellow line which tracks COP.

Reply: Problem is the spaghetti plots of the COP presentations are at different scales. However, the yellow number in top right corner of each image shows the total path length of the COP. Basically, the smaller the number the less excursion of the COP within the recorded time (20s).

Changes in text: Added to Fig. 2 caption: “Note: individual plots are not to equal scale.”

## Reviewer B

Overall, I think this is a good report. My criticisms mainly concern details of wording and writing style.

Page 4, 71-78: I think it would be helpful to give a few examples, early on, of what is meant by adult spinal deformity. We learn early on that it's a burden, it's progressive, contributes to disability, and surgery may be ineffective. But, as is, it's not until the next page, line 92, that the reader learns that hyperkyphosis and scoliosis are a couple examples.

Reply: We added the technical definition to line 71...

Changes in text: “Adult spinal deformity (ASD), technically defined as either having scoliosis  $>20^\circ$ , sagittal vertical axis  $>5$  cm, pelvic tilt  $>25^\circ$  and/or thoracic kyphosis  $>60^\circ$ , is a significant source of the Global Burden of Disease (1).”

Page 5, line 96: Is there a particular reason why the date of first presentation has been included? That's important in a narrative report for a legal case but usually isn't a part of a health care case report.

Reply: We removed the day of the month.

Changes in text: “In June, 2022, a 69-year old female...”

Repetition and inconsistency: line 97 says “headaches (2x/month)”. Lines 100-101 say “She also reported having migraine and stress headaches approximately two times per month”.

Does the journal want numbers under 10 as text or numerals? Whichever – don't switch back and forth, and don't tell us about the headaches twice.

Reply: Agreed.

Changes in text: Took out the second mention of headaches.

Lines 108-109, "The uppermost end of the Harrington rod could be palpated through the skin." That's stated as if the reader already knows she has a Harrington rod. That maybe should have been worked in to lines 97-98 (mention of surgery.)

Reply: Agreed.

Changes in text: "The patient underwent surgical stabilization for scoliosis at age 16 involving a single Harrington rod placed from T10 to L4."

Lines 111-112, re "the straight leg raiser was positive bilaterally at 45° due to low back pain and hamstring tightness". Instead of saying it's "positive", it would be more informative the say "performance of a straight leg raiser was limited to 45° due to low back pain and hamstring tightness".

Reply: Agreed.

Changes in text: "..., and the straight leg raiser was limited bilaterally to 45° due to low back pain and hamstring tightness."

Line 120, re, [www.balancetrackingsystems.com](http://www.balancetrackingsystems.com): Although it isn't necessarily wrong to include a URL, most journals want the name of the company and its location.

Reply: Agreed.

Changes in text: "Standing balance testing was performed using the BTrackS balance plate (Balance Tracking Systems, San Diego, CA) (9)."

That paragraph running from line 128 to line 151. You might consider breaking it up. Perhaps the section on the 5 exercises could be its own paragraph - starting with lines 133-134, "The patient also performed a series of 5 mirror image exercises" and ending with line 144, "The fifth exercise was horizontal arm extensions with resistance".

Reply: We broke the long paragraph up into 3.

Changes in text: See section.

Punctuation: Line 98: "16 years", not "16-years". Line 157: "7 months", not "7-months".

Reply: Changed.

Changes in text: Changed.

Line 123-124 says, "The patient demonstrated postural control impairment as the COP derived parameters for the 'vestibular' condition were high." But it isn't until line 160 that the reader learns that the vestibular condition is "eyes closed; standing on foam". That information should appear at the first mention of vestibular condition.

Reply: Agreed.

Changes in text: Now reads for lines 123...: "for the 'vestibular' condition (eyes closed; standing on foam) were high (14,15).

Line 162-163, re “The patient changed her percentile score...” That’s weird phrasing, as if she grabbed a pencil and actively did something. Maybe, “The patient’s percentile score for the vestibular condition changed from the 10th percentile to better than the 70th percentile”?

Reply: Agreed, changed as indicated.

Changes in text: “The patient’s percentile score for the vestibular condition changed from the 10<sup>th</sup> percentile to better than the 70<sup>th</sup> percentile.”

Line 173. Prior to this point the patient has been referred to as “she” and “her”, so it seems awkward to use “they” here (“The patient stated they ‘felt good’...”)

Reply: Changed to ‘she’

Changes in text: “The patient reported she ‘felt good’...”

Lines 186-187: Re, “There are limitations to this case. First, this is a single case and despite the dramatic improvement in postural control (balance), no causal inference can be made”: First, you’ve already stated several times that the patient made substantial improvement, so it seems a little ‘over the top’ to mention it again and to add the word ‘dramatic’. More importantly – and I might be misinterpreting you, I understand, sorry if that’s so – the sentences seem to reflect a lack of understanding of why a single case cannot definitively show that the care caused the effect, the lack of control over other possible contributing factors. In teaching research classes, I often used a hypothetical example of providing chiropractic care to a woman with headaches. After 10 visits the headaches were gone! The doctor concludes chiropractic works! Except that the DC failed to consider that while the woman was receiving care, she had also started a yoga class, started meditating, stopped eating the massive quantities of sugar she had been consuming, and divorced her asshole husband. So, maybe it was the care, but maybe it was the other factors (I believe this is called a “historical” threat to internal validity.)

Reply: We understand point – we removed ‘dramatic.’

Changes in text: Now reads: “First, this is a single case and despite the improvement in postural control (balance), no causal inference can be made.”

Line 224, “...in this patient as all COP parameters...” Insert a comma after “patient”.

Reply: Agreed.

Changes in text: Added comma.

Lines 239-241: SUCH a convoluted sentence “Although not testable, we argue the chances of the patient falling and risking injury and other untoward consequences, particularly considering the comorbidity of osteopenia, have been dramatically reduced.” First, there have been studies associating improved postural balance with decreased fall risk. Did you already cite some? I can’t go back and look, but it shouldn’t be hard to find a couple. So, while it is true that you can’t test that hypothesis on that particular patient, it isn’t an out-on-a-limb statement. Secondly, the way you inserted the untoward consequences and osteopenia makes for awkward reading. Maybe something like, “Improved balance has been associated with reduced fall risk (ref X). Fall reduction in elderly patients may be preventive for many



untoward consequences; note that the patient of this report also had a comorbidity of osteopenia.”

Reply: Agreed.

Changes in text: “Improved balance has been associated with reduced fall risk (30). Fall reduction in elderly patients may be preventive for many untoward consequences; note that the patient of this report also had a comorbidity of osteopenia. Further research is needed to elucidate which treatment approaches are efficacious at improving postural balance control in those with spinal deformity.”

Ref 30:

30. El-Khoury F, Cassou B, Charles MA, Dargent-Molina P. The effect of fall prevention exercise programmes on fall induced injuries in community dwelling older adults: systematic review and meta-analysis of randomised controlled trials. *BMJ*. 2013 Oct 29;347:f6234.

### Reviewer C

Does the patient have any comorbidities or medical conditions that would be a contributing factor to her back pain and postural imbalance?

Reply: Regarding back pain, the rod with aging (sedentary behavior) as well as having stooped posture is well enough to contribute to pains, no other comorbidities were revealed. Regarding imbalance, both age and spine deformity are known to contribute to this, and to control for age, age-appropriate norms (percentiles) were used to compare center of pressure total path length outcomes to.

Changes in text: None.

What did past physiotherapy treatment sessions consist of?

Reply: Physio was for hip issue – nothing to do with posture or scoliosis.

Changes in text: “The patient reported past physiotherapy that was directed at a previous hip flexor issue that only provided short-term relief.”

In terms of limitations or discussion- what are other factors that may have led to the reduction of back pain and headaches? Mechanical vs. neurophysiological effects should be explored.

Reply: No sure what is suggested here. Any discussion as to mechanisms are simply theoretical as this is a single case report that cannot answer this type inquiry.

Changes in text: None.

Further detail should be included about the scientific and possible neurophysiological effects from the treatment.

Reply: We discussed the fact that the small posture change is unlikely to explain the improved balance, and that the whole body vibration likely contributed significantly to this. Further, it is unknown how WBV improves balance, but a possible mechanism was discussed using the reference by Rigoni et al. 2023 Sci Reports.

Changes in text: None.