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Critical Appraisal of "Immediate Changes in Spinal Heights and Pain After Aquatic Vertical Traction in Patients with Persistent Low Back Symptoms: A Crossover Clinical Trial" by Simmerman et al -- An Opinion Piece

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Critical Appraisal of “Immediate Changes in Spinal Heights and Pain After Aquatic Vertical Traction in Patients with Persistent Low Back Symptoms: A Crossover Clinical Trial” by Simmerman et al – An Opinion Piece

Abstract

Purpose: The purpose of this paper is to critically review the article, Immediate changes in spinal height and pain after aquatic vertical traction in patients with persistent low back symptoms: a crossover clinical trial. *PM R.*2011 May;3(5):447-57. [PMID: 21570033] doi: 10.1016/j.pmrj.2011.01.010. **Methods:** Study, key evidence including study design, sample population, procedure, outcome measures, and results were summarized. Critical appraisal of the study's internal, external, and statistical validity followed. **Results:** In a crossover study of 61 total subjects, mean age 59.6 years, fifteen minutes of supine land-based flexion and weighted aquatic vertical traction were applied in both groups preceded by a uniform loading and unloading procedure. Both interventions showed a significant increase in spinal height compared to pre-intervention height ($P < .0001$). Pain symptoms improved significantly more after aquatic vertical traction compared to the land-based supine flexion intervention ($P < .0034$). Internal validity was threatened by vague inclusion criteria, length of spinal cord affected by the interventions, and inconsistency in days between sessions. External validity was threatened by the age range (40 to 80) of subjects included and a lack of reporting crucial pieces of baseline spinal height and pain centralization data. Poor power, no calculated effect size, lack of setting statistical significance a priori, and incomplete data reporting threaten the statistical validity of this study. **Conclusion:** Fifteen minutes of supine land-based flexion and fifteen minutes of aquatic vertical traction both can be effective in reducing symptoms of low back pain and elongating the spine. However, poor reporting of data and heterogeneity of spinal areas affected by the interventions threaten the validity of this study.

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ABSTRACT

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Keywords: traction, aquatic, spinal height

BACKGROUND

In 2011, Simmerman et al sought investigate the effect of aquatic vertical traction on spinal height, pain intensity, and centralization response compared with a land-based supine flexion position for patients with low back pain and signs of nerve root compression.[1] This paper is a critical appraisal of that article. The authors (Simmerman et al) identified the article as a single-blind, repeated-measures crossover design. The question being asked was, "In patients with low back pain, is aquatic vertical traction more effective in reducing symptoms (caused by progression of disk degeneration and loss of spinal height) and elongating the spine compared to the land-based supine flexion position?"

CLINICAL BOTTOM LINE

Fifteen minutes of supine land-based flexion and fifteen minutes of aquatic vertical traction both appear effective in reducing symptoms of low back pain, centralization of symptoms, and elongating the spine column. However, poor reporting of data and heterogeneity of spinal areas affected by the interventions threaten the validity of results.

SUMMARY OF KEY EVIDENCE

Study Design: Crossover Clinical Trial

R	0	X1	0	X2	0
	0	X2	0	X1	0

Sample Characteristics

1. Of the 98 subjects recruited for the study, only 61 were included in the data analysis. The total number of subjects who qualified for the study was 61: 28 males and 32 females, all recruited through mailers and posters in the local community. The mean age of the subjects was 59.6 ± 2.1
2. All participants experienced low back pain and/or distally radiating numbness within the 24-hours prior to evaluation, pain ≤ 7/10 on the numerical rating scale (NRS), and signs of nerve root compression. Randomization occurred via coin flip into one of two groups: land-based supine flexion first or aquatic vertical traction first. All subjects included in the final data analysis (n=60) met the inclusion criteria.

Procedures

Treatment occurred twice on two different days. All participants began by performing 10 minutes of supine lying, followed by15 minutes of loaded walking, and then 5 minutes of unloaded sitting before each intervention. Subjects were then treated according to their assigned group. Land-based supine flexion occurred for 15 minutes with the hips and knees flexed to 90° and 65° respectively. Aquatic vertical traction was applied with two 5-lb ankle weights (secured around the ankles) and two pool noodles (secured under each arm) in 8 feet of water for 15 minutes with hip position between 15° of flexion and 5° of extension.

Outcome Measures

Spinal height was measured using the 235 Heightronic™ Digital Stadiometer (QuickMedical Measurement Concepts, Snoqualmie, WA) after the 5-minute unloaded sitting and after the 15-minute intervention on both treatment days. Pain measures were recorded on a numeric rating scale and pain location diagram during unloaded sitting before and after the intervention on both treatment days.

Results

Both intervention groups showed a significant increase in spinal height pre-to-post intervention height ($P < .0001$). The mean (SD) height change after aquatic vertical traction was 4.99 ± 2.88 mm. The mean (SD) height change after supine land-based flexion was 4.21 ± 2.53 mm. No between group changes in height was noted. Pain symptoms improved significantly more after aquatic vertical traction compared to land-based supine flexion intervention ($P < .0034$). The pain (mean ± SD) decreased by 1.7 ± 1.7 cm on the NRS after the supine land-based flexion intervention, whereas it decreased by 2.7 ± 2.1 cm after the aquatic vertical traction. After the aquatic vertical traction condition, 50 subjects (83%) reported centralization, 9 no change (15%), and one peripheralization of symptoms (2%), whereas, for the supine land-based flexion condition, 31 subjects (52%) reported centralization, 23 no change (38%), and 6 peripheralization of symptoms (10%) ($P < .0001$). Positive correlations were noted in the aquatic vertical traction intervention between change in spinal height and pain reduction ($P = .001$) and between spinal height change and pain centralization ($P = .013$).

APPRAISAL

Internal Validity

Threats. There were 10 threats to internal validity as follows: 1) Signs of nerve root compression marking inclusion into the study were not well defined as to extent and how measured. 2) No description was given of how the subject list used for randomization was formed, allowing for potential bias in randomization. 3) Lack of concealment of the random assignment of the subjects to the intervention group. 4) The digital stadiometer utilized is meant to measure standing stature from a wall-mounted position and not spinal height in a seated position, which affects the validity of its use. 5) Subject familiarization with the digital stadiometer was performed during data collection as opposed to a separate session prior to data collection. 6) The aquatic vertical traction intervention affected the entire length of the vertebral column, whereas the land-based supine flexion affected mainly the lumbar and partially the cervical curvature, creating inconsistencies in treatment area that could affect outcomes. 7) The ambient temperature differed between interventions, affecting the elasticity of the soft tissue. 8) Differences in the effects of weight/body type and buoyancy affecting depth of submersion into the water were not addressed during aquatic vertical traction. 9) Subjects may have been included with conditions contraindicated to the land-based supine flexion intervention. 10) Time between sessions varied between 2 and 7 days, possibly affecting the effectiveness of the intervention.

Strengths. There were three sources of strength related to internal validity in this article: 1) Investigators recording outcome measures were blinded. 2) All subjects underwent identical protocol, eliminating a potential source of bias. 3) Inclusion and exclusion criteria were specified, reducing variability.

External Validity

Threats. In this study, we found 3 threats to external validity: 1) Only examined individuals between the ages of 40 and 80 in the general population, making generalization difficult to younger or older populations, as well as the athletic population. 2) Low back pain symptoms only needed to be present 24 hours prior for inclusion in the study, which does not allow differentiation of outcomes between acute and chronic conditions and their respective practical applicability. 3) Reported “pre-“ data does not include spinal height or pain centralization, making application difficult in determining who may benefit from the interventions studied.

Strengths. We identified two strengths related to external validity in this study: 1) Description of intervention parameters allows for easy reproduction of treatment. 2) Low back pain and nerve root compression symptoms are common in the 40-80 year old age range, making results readily applicable in this population.

Statistical Validity

Threats. After careful considerations, we identified 6 threats to the statistical validity of this study: 1) While the mathematical for determining a sample size for 80% power was presented, methods could be further clarified. 2) Effect size was not calculated. 3) No significance was set a priori for statistical analyses. 4) Authors did not state that the parametric test assumptions were met, threatening the validity of the results. 5) Data reported is incomplete and does not present pre-intervention values for two outcome measures nor post-intervention values. 6) Significance was not reported for the Wilcoxon signed-ranks test evaluating changes in mean centralization of pain.

Strengths. There were 6 strengths of the statistical validity in this study: 1) Parametric and non-parametric tests were used appropriately in evaluating interval and ordinal data. 2) Methodological attempts were made to counterbalance variability between groups. 3) A power analysis was conducted. 4) Inferential statistics were used after randomization to determine whether the two groups were similar at baseline. 5) The results of between-group statistical comparisons are reported for at least one key outcome. 6) The results provide measures of variability for at least one key outcome.

LEVEL OF EVIDENCE

According to the Oxford Centre Evidence-based Medicine, the level of evidence for this study is 2b.[2] This level is defined as an individual cohort study.

APPLICATION

Low back pain with or without symptoms of nerve root compression is a common condition affecting members of many populations. Both aquatic vertical traction and lumbar supine flexion positioning appear to be viable interventions to increase spinal height in patients 40 to 80 years of age with low back pain and signs of nerve root compression. And while aquatic vertical traction with pool noodles is not practical in all settings or patient populations compared to supine or positional land-based traction, it appears to be more effective in a temporary reduction of pain intensity and centralized symptoms. In patients where aquatic therapy is not contraindicated and aligns with treatment goals and available resources, clinicians should consider incorporating the intervention

into the treatment protocol as well as educating patients on how to perform the intervention independently assuming they have access to any private or public pool.

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