Spinal Height Change in Response to Sustained and Repetitive Prone Lumbar Extension After a Period of Spinal Unloading

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Abstract

Objective: The purpose of this study was to investigate if differences in spinal height changes in healthy individuals were observed after a period of spinal unloading using repetitive as compared with sustained lumbar extension exercises.

Methods: This study used a pretest, posttest, crossover design. Asymptomatic participants were recruited using convenience sampling. Thirty-two participants (15 male; 17 female) without back pain were included in the data analysis (mean, 24.4 years; range, 20-41 years). Participants performed sustained or repetitive prone lumbar extension exercises after 1 hour of sustained spinal unloading. Spinal height was measured using a stadiometer before and after the repetitive and sustained prone lumbar extension exercises.

Results: Paired *t* tests revealed no significant difference in spine height after repetitive ($P = .774$) or sustained ($P = .545$) prone lumbar extension after a period of spinal unloading. No significant difference between spinal height changes occurred between sustained (mean [SD], −0.28 [2.59] mm) and repetitive (mean [SD], −0.12 [2.42] mm) lumbar extension ($P = .756$).

Conclusion: In this group of asymptomatic individuals, sustained and repetitive lumbar extension exercises did not appear to affect spinal height after a period of spinal unloading. (J Manipulative Physiol Ther 2014;37:586-592)

Key Index Terms: *Intervertebral Disk; Spine; Prone Position; Body Height*

Intervertebral disk health is largely dependent on the movement of fluid in and out of its boundaries to ensure proper nutritional state and mechanical function during periods of spinal loading and unloading. Spinal movement does not occur in isolation and influences the intervertebral disk.[1] Because of the intervertebral disk viscoelastic properties, periods of spinal loading tend to result in fluid exudation from the intervertebral disk, whereas periods of spinal unloading cause the intervertebral disk to imbibe fluid.[2] In response to these behaviors, healthy individuals experience a 19.3-mm or 1.1% loss in total stature between first arising and the end of the day because of diurnal fluctuations in spinal height.[3–5]

Magnetic resonance imaging (MRI) and stadiometry can be used to measure spine height change associated with different postures, loads, and interventions. The stadiometer provides a reliable[6,7] and valid[8,9] indirect measure of lumbar intervertebral disk height changes.[9,10]

Stadiometry research has demonstrated how interventions and body positions influence intervertebral disk height. Loading conditions have been shown to be more predictive of changes in spinal height than posture or position. After periods of spinal loading, both flexion and extension produce an increase in spinal height.[9,11–13] However, the affect

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Paper submitted February 16, 2013; in revised form September 10, 2013; accepted September 24, 2013.
0161-4754

http://dx.doi.org/10.1016/j.jmpt.2014.08.001

interventions have on spinal height change after periods of prolonged unloading have not been studied.

It has been demonstrated that sustained and repetitive lumbar extension exercises restore spinal height after periods of spinal loading. Sustained and repetitive lumbar extension exercises are frequently started after periods of prolonged unloading such as sleep and then periodically performed throughout the day. Although the use of lumbar extension appears to be effective in the prevention[14] of low back pain (LBP), evidence is lacking with regard to a rationale for success.[15]

Increases in spinal height have been detected after lumbar extension interventions.[9,11,13,16,17] Magnusson et al[13] found an increase in spine height with sustained and repetitive passive prone extension using a moving table after a period of spinal loading. These results may not be representative of traditional press-up exercises performed by participants using their arms. Recently, Beattie and coworkers[16] discovered an increase in spine height with active prone press-ups after performing posterior to anterior spinal mobilization with the patient in an unloaded prone position. Owens et al[11] and Kourtis et al[9] found an increase in spinal height in response to sustained passive extension after a period of spinal loading. However, the above studies provide limited insight into changes in spine height after periods of spinal unloading that would mimic traditional prone press-up exercises after a period of spinal unloading when the intervertebral disk is fully hydrated.

Certain gaps in the literature remain. No research to date has investigated the effects of active sustained vs repetitive prone extension on spinal height after periods of spinal unloading. Therefore, the purposes of this research were to investigate if, after a period of spinal unloading, there was a difference in (1) spine height after repetitive prone lumbar extension, (2) spine height after sustained prone lumbar extension, and (3) spine height changes after repetitive prone lumbar extension as compared with sustained prone lumbar extension. The authors hypothesized that healthy participants would demonstrate a change in spine height after both repetitive prone lumbar extension and sustained prone lumbar extension.

Methods

Participants

The Texas Tech University Health Sciences Center Institutional Review Board granted approval for this project. A total of 46 asymptomatic individuals, 23 women and 23 men, were recruited from a sample of convenience. Medical history was reviewed before the session in order to screen for inclusion and exclusion criteria. Participants were included if they were asymptomatic, were between the ages of 20 and 45 years, and had no history of LBP. Participants were excluded from the study if they reported the following: (1) LBP in the past year that required medical attention, (2) inability to lie still for 1 hour or perform a prone press-up without pain, (3) spinal deformity such as scoliosis or Scheuermann disease, (4) a history of spinal surgery, (5) pregnancy, (6) uncorrectable visual impairments, and (7) neurologic and connective tissue disorders.

Design

A pretest, posttest crossover design was used to determine how spinal height changes in response to sustained and repetitive prone lumbar extension after a period of spinal unloading.

Apparatus and Measurement Position

A commercially available stadiometer (235 Heightronic Digital Stadiometer; QuickMedical; Issaquah, WA) mounted to a custom wooden frame measured spine height.[11] The protocol used for measurements of spine height has been previously described.[12] Participants were asked to exhale normally and hold their breath for a short time while stadiometric measurement was taken.

Testing Sequence

Participants watched a video that explained and demonstrated the procedures, as well as read and signed a written informed consent form before participation. They completed a questionnaire regarding demographic information and medical history. A researcher recorded height and weight. Calibration of the stadiometer was performed before testing and prior to daily data collection.

Familiarization Session (Stadiometer). Each participant underwent training in positioning him/herself consistently in the stadiometer (Figure 1). Researchers familiarized the participants with the measurement technique using a previously established protocol.[7,11,12,18] The participant had to achieve an SD less than 1.3 mm for 10 measurements to be included in the study.[18] The researcher was blind to both the measurements and which intervention the participant performed before the measurement. The measurements were recorded into the correct cell in Microsoft Excel. A coin toss was used to randomly assign participants to 1 of 2 groups: (1) completion of sustained prone lumbar extension first or (2) completion of repetitive prone lumbar extension first. Participants completed one intervention and then completed the alternate form of prone lumbar extension. All participants underwent the testing sequence after a period of spinal unloading.

Familiarization Session (Prone Lumbar Extension). In order to perform sustained and repetitive lumbar extension at the same height during both interventions, the participant performed prone lumbar extension. The range of motion was assessed and recorded using a tape measure to measure the distance from the sternal notch to the table (Figure 2). This has shown to be a