

Axial loading of the lumbar spine in persons with acute low back pain: a kinematic analysis.

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Introduction:

Persons with acute low back pain often experience increased symptoms during standing or sitting as compared to lying supine. Magnetic resonance imaging (MRI), conventionally performed in supine, is used to detect symptom-producing anatomic structures. However, if supine is the position of comfort, the same pathoanatomical relationship present during an upright symptomatic position may not be apparent on conventional MRI. It has been hypothesized that the intervertebral disc experiences a different axial loading pattern, which may account for symptom alteration, when the trunk is upright compared to supine. A device capable of loading the body in supine during MRI has made it possible to image individuals in simulated upright symptomatic positions.

Purpose:

To assess the feasibility of utilizing an axial loading device on individuals with acute low back pain and to assess the sagittal plane kinematics and posterior disc bulge of the lumbar spine during axial loaded MRI in persons with acute low back pain.

Methods:

One individual with acute low back pain participated in this pilot study. The participant was imaged under two supine conditions, unloaded and axially loaded. Axial load was applied using a Dynawell[R] (Dynawell, Int., Billdal, Sweden) L-spine loading apparatus. The apparatus was validated and calibrated for external loads (ICC > 0.90, SEM < 0.75 lb). The axial loading apparatus consisted of an upper body harness strapped to a foot platform in which loads were adjusted through the tension of the straps. To simulate upright posture, a load of 60% of bodyweight was used to load the lumbar spine. Participants were imaged in the unloaded supine condition, followed by a period of ten minutes in the axial loading device. After ten minutes, the load was readjusted to account for any changes in the calculated load and the participant was imaged in the axially loaded condition. Total lumbar curvature, lumbar spine height, intervertebral disc height, intervertebral angle and posterior disc bulge were analyzed using Slice-o-Matic imaging software (Tomovision, Inc., Montreal, Canada).

Results:

Changes in total lumbar curvature and lumbar spine height for this subject in the unloaded and loaded conditions are displayed in Figure 1. Intervertebral angle and intervertebral disc height is displayed in Figure 2. Disc bulges present in unloaded

condition were augmented with axial loading and a disc bulge that was not detected during the unloaded condition was measured during axial loading (Table 1).

Conclusion:

Axial loading during MRI was used safely and effectively in a person with acute low back pain. When compared to conventional MRI, axial loading produced an increase in lumbar lordosis, a decrease in lumbar spine height and bidirectional changes in intervertebral disc height (increase at L1-L3 and decrease at L4 and L5). Axial loading produced changes in posterior disc bulge that were not detectable during conventional imaging.

Table 1. Posterior bulge of intervertebral discs during unloaded (UL) and axially loaded (AL) conditions.

	Posterior Disc Bulge (mm)									
	L1-L2		L2-L3		L3-L4		L4-L5		L2-S1	
	UL	AL	UL	AL	UL	AL	UL	AL	UL	AL
Subject	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.9	2.5