Axially loaded MRI of the lumbar spine in asymptomatic individuals

BARBRO DANIELSON MD, PhD[1], JAN WILLÉN MD, PhD[2]

From the Departments of Radiology[1] and of Orthopaedics[2] Sahlgrenska University Hospital, Göteborg, Sweden

MRI and CT has to a great extent replaced myelography as a diagnostic tool in lumbar spinal disorders. However, the drawback is that these examinations are performed in a supine relaxed position. Recently it has been shown that the dural sac cross sectional area (DCSA) decreases significantly in axial loading of the spine in patients with clinical signs of neurogenic claudication and sciatica (1, 2).
Results from several studies on conventional radiography, CT and MRI conducted on asymptomatic individuals have been published. In a high percentage disc degeneration, bulging or protrusions are described (3).

Purpose: **1)** to compare the effect of axial loading of the lumbar spine in a supine position during MRI in asymptomatic individuals with what has been found in symptomatic individuals.
2) to evaluate the effects on the DCSA of different magnitudes of axial loading as well as of different times during which the load is applied.

Material: **43** healthy individuals, 22 female and 21 male between 20 and 60 years of age were examined. Seven individuals were selected for reexamination.

Method: **MRI** was performed on a **1.0 T** (Magnetom Impact, Siemens) machine using a surface coil.
1) All subjects were first examined in **psoas relaxed position (PRP)** with sagittal T2 as well as axial T1 and T2 sequences. The disc levels from **L3 to S1** were evaluated. The **axially loaded position (ACE)** of the spine was achieved using a non magnetic compression device and a harness Fig 1 (DynaWell™). The load was 50% of the subjects body weight. The load was applied during at least five minutes. After that axial T1 and T2 weighted sequences were performed.
2) The reexamination was performed at two different occasions, with an applied load of 25 and 50 per cent of the individuals body weight, respectively. Axial T1 and T2-weighted sequences were conducted after 5, 20, 40 and 60 minutes of axial loading. The disc levels from L3 to L5 were evaluated.
The **DCSA** (dural sac cross sectional area) was determined by using a measurement program on a digital image view station. A statistically significant decrease in DCSA from PRP to ACE had occurred if the decrease exceeded 15 mm^2. Recess and foraminal narrowing was also determined.

Results and Discussion: **1)** In the 43 individuals **129 disc levels** were examined. A significant **decrease in DCSA** (>15mm^2) **from PRP to ACE** was found on **35 (27%) disc levels in 24 (56%) individuals** (Fig 2). The mean decrease in DCSA was 25 (range 15 – 62) mm^2. A decrease in DCSA between PRP and ACE was most often found on the L4-L5 disc level and in increasing frequency with age. There was no difference between females and males.
In ACE the DCSA was below 100 mm^2 on 24 (19%) levels in 16 (37%) subjects and below 75 mm^2 on 7 (5%) levels in 7 (16%) individuals.
A significant decrease of DCSA below 100 mm^2 from PRP to ACE was only found at five levels in four subjects.
2) In the seven reexamined individuals 14 disc levels were evaluated. In all individuals a significant decrease in DCSA was found on L4 - L5 and in five on L3 - L4. After 5 minutes during ACE a significant decrease in DCSA on one or two disc levels was found in five individuals, in three of which after a load of 25% and in two after 50 %. In two subjects a decrease in DCSA was found after a load of 50 % during 20 and 40 minutes, respectively.

A decrease in DCSA between PRP and ACE is more frequent among the patients than in asymptomatic subjects, 76% compared to 56%. In 24% of the patients and in 9% of the asymptomatic individuals a decrease in DCSA from above to below 100 mm^2 was found (Fig 3).

Conclusion: Comparing the results from the studies on patients and asymptomatic individuals after MRI in supine psoas relaxed position - PRP and in supine axial compression and extension -ACE, a substantial difference in effect of axial loading on the dural cross sectional area in these two groups is demonstrated.
These findings highly support the recommendation to perform MRI examination of the lumbar spine in axial loaded as well as in psoas relaxed position.
The applied load should be 50 per cent of the body weight of the subject and the load should be maintained for at least five minutes.

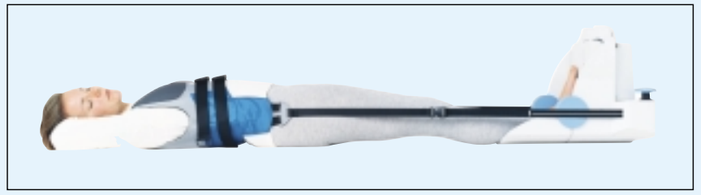
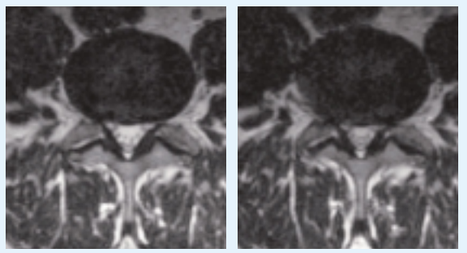


Fig 1: Axial compression of the lumbar spine with the DynaWellTM

Fig 2: DCSA in PRP (filled squares) and ACE (open circles) at each disc level



a) b)

Fig 3: Asymptomatic 58 year old male
a) PRP - DCSA 100 mm^2 , b) ACE - DCSA 70 mm^2

1: Danielson BI et al: Axial loading of the spine during CT and MR in patients with suspected lumbar spinal stenosis. Acta Radiol. 1998; 39: 604-11.
2: Willén J et al: Dynamic effects on the lumbar spinal canal. Axially loaded CT-myelography and MRI in patients with sciatica and/or neurogenic claudication. Spine 1997; Dec 15 ; 22 (24): 2968-76.
3 : Weishaupt D et al: MR imaging of the lumbar spine: prevalence of intervertebral disk extrusion and sequestration, nerve root compression, end plate abnormalities, and osteoarthritis of the facet joints in asymptomatic volunteers. Radiology 1998; Dec 209 (3): 661-6.