



# P109

## **Axial loading during MRI induce lumbar foraminal area changes and may be useful in diagnostics of nerve compromise**

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# Introduction

- Lumbar foraminal stenosis is common with a prevalence of about 10% (1)
- Assessment is conventionally performed with MRI in supine position
- A few reports using upright MRI indicating a decrease of lumbar foraminal area at standing, however no reliability measurements have been reported (1,2,3)
- How loading of the spine in a prone position, while also having the ability to get high quality MRI images, affect foraminal area has not previously been reported

1) Splendiani A, et al. Magnetic resonance imaging (MRI) of the lumbar spine with dedicated G-scan machine in the upright position: a retrospective study and our experience in 10 years with 4305 patients. *Radiol Med.* 2016;121(1):38-44.

2) Kubosch D, et al. The Lumbar Spine as a Dynamic Structure Depicted in Upright MRI. *Medicine (Baltimore)*. 2015;94(32):e1299.

3) Lang G, et al. Preoperative Assessment of Neural Elements in Lumbar Spinal Stenosis by Upright Magnetic Resonance Imaging: An Implication for Routine Practice? *Cureus*. 2018;10(4):e2440.



# Aim

To investigate if and how axial loading of the spine affects the lumbar intervertebral foramina evaluated on MRI



# Methods

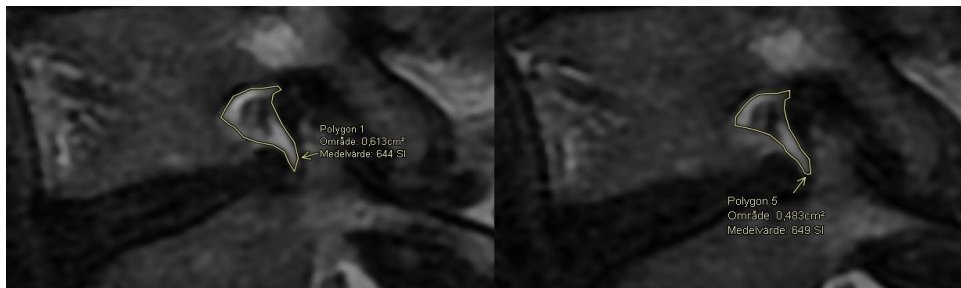
- Cohort of 89 LBP patients, mean age 43 years, range 27- 66
- Lumbar MRI performed in relaxed supine position followed by axial loading in supine position using the Dynawell© compression device





# Methods

- The area of the foramina L3-S1 (in total 534 foramina) was determined (T2W) using a free hand polygonal tool
- Qualitative grading of the foramina were performed (T1W and T2W) by using the Lee grading system (4), grading 0-3



*Example of L4–5  
foraminal area at  
unloaded MRI (left) and  
with axial loading (right)*



# Methods

- One radiologist performed measurements and quantitative grading of all foramina
- The sagittal image with the smallest foraminal area was used
- For 10 patients (60 foramina) repeated measurements as well as measurement by a second radiologist were performed - to evaluate intra- and inter-observer variations



## Results – area measurement

- Intra class correlation coefficient for foraminal area measurement was 0.96 and 0.76 for intra-observer respective inter-observer agreement
- Overall, a mean reduction of 2.2%, unloaded-loaded MRI (mean 0.89 and 0.87 cm<sup>2</sup> respectively) ( $p = 0.002$ )
- A large variation in load-induced foraminal area change, range 58% increase to 42% decrease



## Results – area measurement

- Stratified for lumbar level, a mean area reduction during loading was found for L3/L4 and L4/L5 foramina, but not for L5/S1

Lumbar level	Mean change loaded/unloaded	p-value
L3/L4	↓ 0.03 cm <sup>2</sup>	0.036
L4/L5	↓ 0.03 cm <sup>2</sup>	0.004
L5/S1	0.00	ns





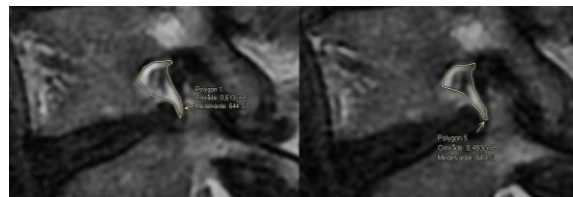
## Results – qualitative assessment

- With qualitative foramina stenosis grading differences between unloaded/ loaded MRI was seen ( $p < 0.001$ )
- In 25% of the foramina, a change of foraminal stenosis grade (higher or lower grade) occurred with loaded MRI, with a higher grading determined in 19% of all foramina ( $p < 0.001$ )



## Results – area measurement / qualitative assessment

- For 21% of the foramina, in which loading induced a decreased foraminal area, a concomitant higher qualitative grade was observed





# Discussion

- Overall, a small reduction of mean foraminal area was induced with axial loading during MRI
- However, the load-induced foraminal area change demonstrated a large dynamical range, in this group of LBP patients without radiculopathy
- MRI with loading induced a higher foraminal stenosis grade in about 1/5 of these patients, indicating that the applied load induce changes of a magnitude that might be of clinical relevance
- This method have potential to improve diagnostics when conventional MRI findings do not match with clinical symptoms of lumbar radiculopathy



# Summary points

- Loading of the spine in a supine position during MRI affect lumbar foraminal area with large variations
- Effect of the loading on the foramina were more pronounced for L3/4 and L4/5 than for L5/S1
- Axial loading of the spine during MRI may unmask lumbar foraminal nerve root compromise not seen in conventional unloaded supine position



# Disclosure

None of the authors has any  
potential conflict of interest