

## Quantitative Evidence for Gender Specific Differences in Age Related Degeneration of Lumbar Foramina.

Joel S Beckett MD; MHS; Christine S Ahn BS; Bilwaj K Gaonkar PhD; Luke Macyszyn MD, MA  
University of California, Los Angeles

### Introduction

There is a direct relationship between back pain and age.[1] Degenerative disease, leading to lumbar foramina stenosis, is a leading cause of pain. Thus, we hypothesized that foraminal areas measured across the population should decrease with age. Upon measurement of foraminal areas on T2-weighted magnetic resonance images (MRI), we found the constriction to be more pronounced in females as compared to males.

### Methods

Lumbar vertebral foramina were delineated manually with ITK-SNAP [3] on 100 sagittal T2-weighted MRI of the lumbar spine (200 total neuroforamina). The age distribution of the full data set was (68 +/- 10 years) and the gender distribution was 51 males and 47 females. The mean age for males (69.51 +/- 8.55) and females (69.41 +/- 9.72) did not differ significantly (p-value=0.77) as indicated by a t-test. Foraminal areas for each of the lumbar segments was calculated based on the manually delineated area with in-house software.

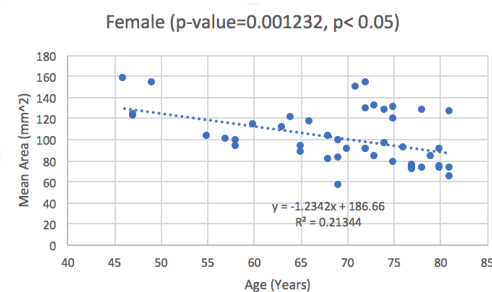
### Results

We calculated the mean lumbar foraminal area by averaging foraminal areas of all lumbar foramina in the image. The mean lumbar foraminal area for females over the entire age range was 101.09 mm<sup>2</sup>, and the mean area for males over the full age range was 106.11 mm<sup>2</sup>. Regression analysis showed that the mean lumbar foraminal area was statistically significantly correlated with age for females (p-value=0.001, R=0.462). The corresponding correlation was not significant for males (p-value 0.55, R=0.08). The fitted regressor and distribution of mean foraminal area with age for females and males is shown in figures 1 and 2 respectively.

### Conclusions

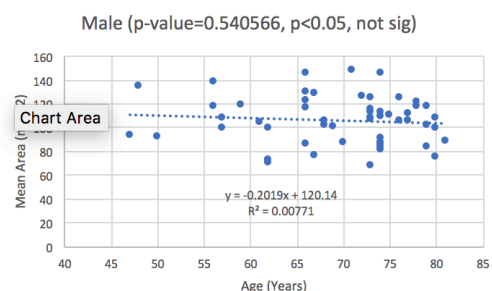
This retrospective study indicates that women have an inverse relationship between lumbar foraminal area and age, while men do not. Further work is needed to confirm and evaluate the etiology of this finding. However, this finding may partially explain why women have a higher prevalence of back pain with age.[2]

**Figure 1**



Variation of mean lumbar foraminal area with age in females

**Figure 2:**



Variation of mean lumbar foraminal area with age in males

### Learning Objectives

Describe quantitative area assessment  
Describe mechanisms of back pain  
Describe changes in neuroforaminal area with age

### References

1. Hoy, D., et al., A systematic review of the global prevalence of low back pain. *Arthritis Rheum*, 2012. 64(6): p. 2028-37.
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3. Yushkevich, P.A., Piven, J., Hazlett, H.C., Smith, R.G., Ho, S., Gee, J.C. and Gerig, G., 2006. User-guided 3D active contour segmentation of anatomical structures: significantly improved efficiency and reliability. *Neuroimage*, 31(3), pp.1116-1128.