

INTRODUCTION

The intervertebral foramen (IVF) have fixed boundaries though its dimensions vary depending on the height of individual discs. Changes to the disc morphology can therefore reduce IVF diameters [1,2,3]. Fujiwara et al., 2001[4] confirmed that the axial rotation decreased the foramen width and area at the rotation side significantly, while significantly increased the foraminal height and area on the opposite side. Through understanding the underlying biomechanics we can further our comprehension of spinal pathologies and treatment strategies.

Purpose

This study aims to identify the variations of the intervertebral disc and the intervertebral foramen during low trunk rotation to further our understanding of its effect on neural compression.

Materials and Methods

Subjects

Volunteers underwent an MRI scan of the lumbar spine in the neutral, left and right rotated position. To minimize motion artifacts, a foam pad was used to hold the subject still during the MRI acquisition.



Fig 1. The position of the subject obtained with rotating to right with shoulder supine and hips at a ninety-degree angle.

Image analysis and data collection

The Sagittal T2 weighted images were used to calculate the dimensions of the IVF and IVD at the L3/L4, L4/L5 and L5/S1 intervertebral levels. The data was analysed using a One-Way ANOVA.

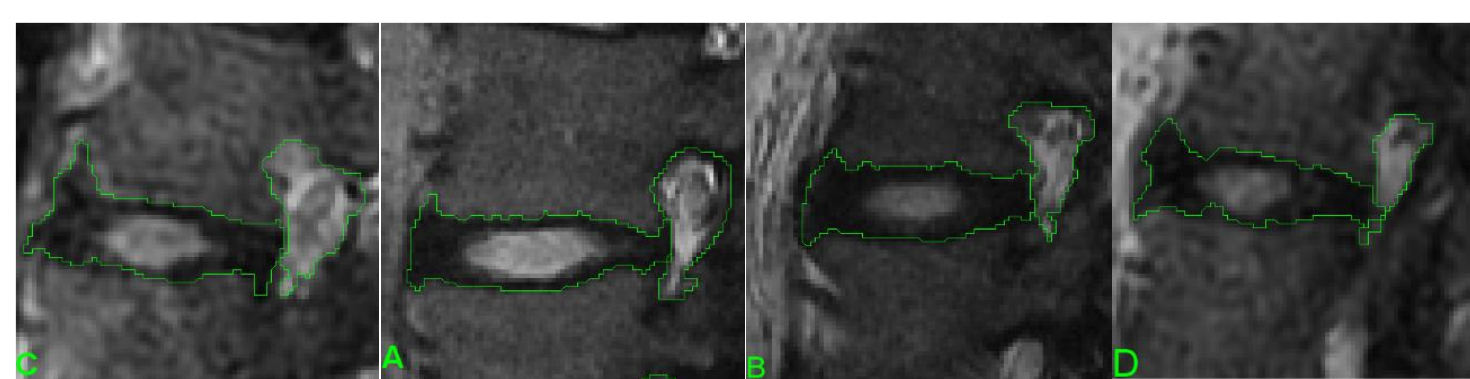


Fig 2. The change of the area, width, and height of the right and left foramen and disc at Neutral position (A and B) and Left Rotation (C and D).

Results

The morphology of the IVF and IVD alter significantly in response to rotation. During rotation the area and width of the IVF at L3/L4 and L4/L5 decrease whilst the IVF at L5/S1 increase on the rotated side ($p < 0.005$). Reciprocal changes are seen on the opposite side. The parasagittal IVD area significantly reduced at all levels and both sides during rotation ($p < 0.005$).

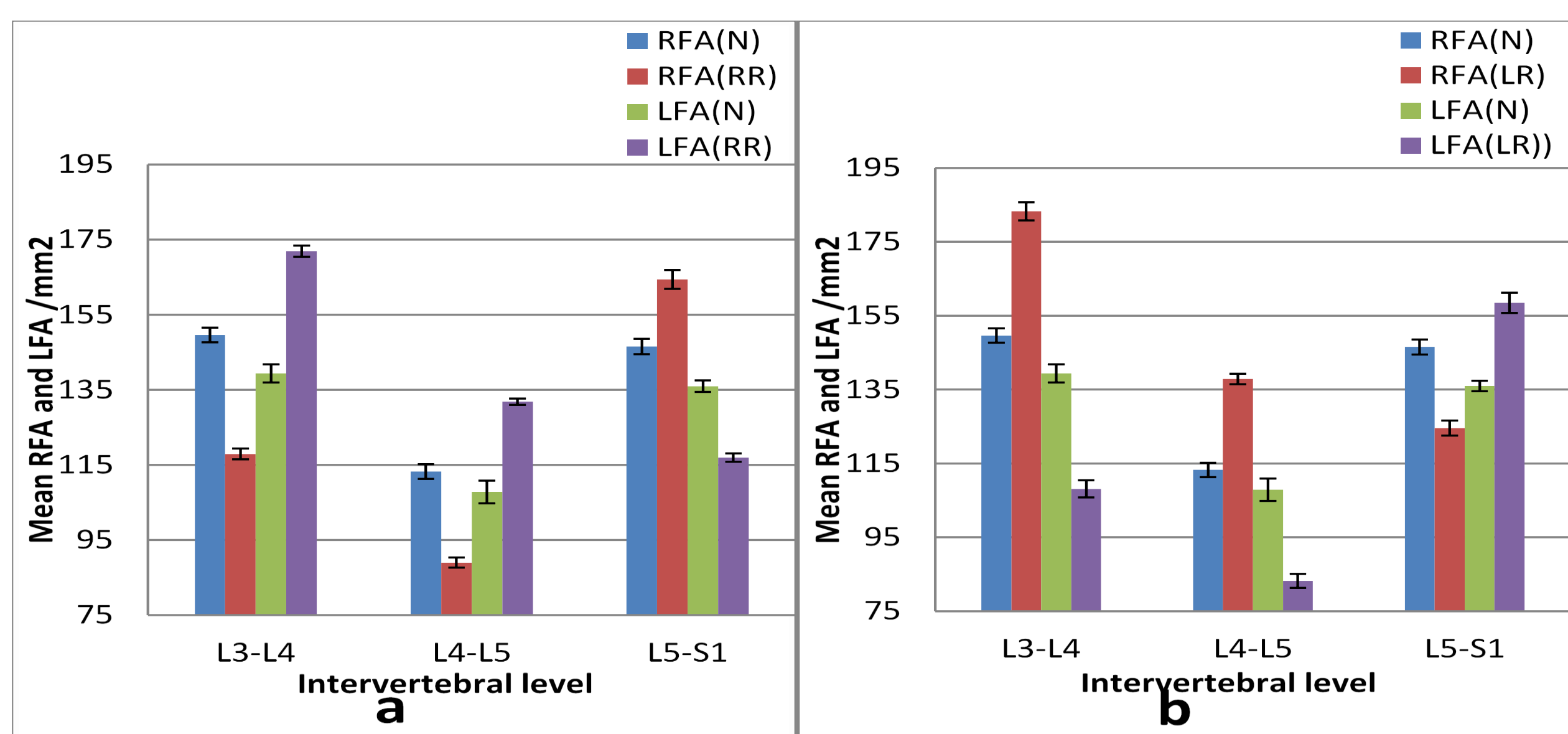


Fig. 3. (a) Right foramen area (RFA) and left foraminal area (LFA) changes during right rotation (RR) compared with neutral position (N), (b) Right (RFA) and left foraminal area (LFA) changes during left rotation (LR) compared with neutral position (N).

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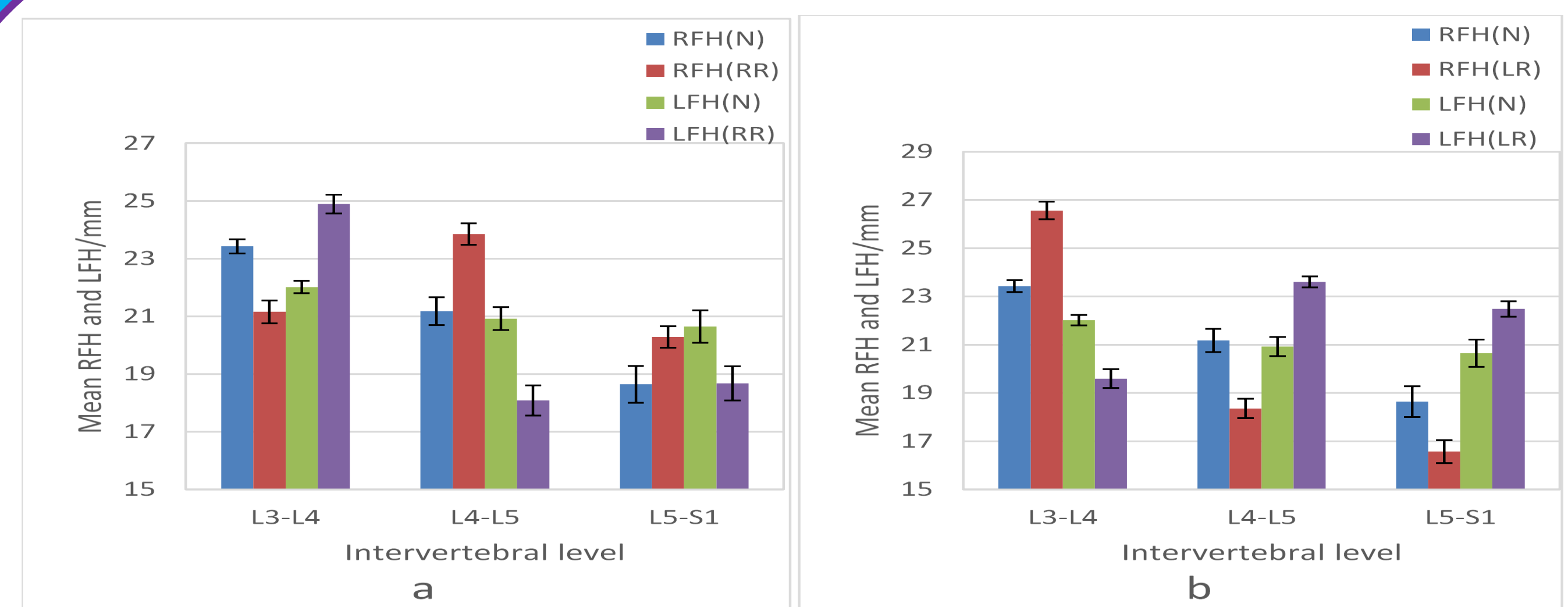


Fig. 4 (a) Right foraminal height (RFH) and left foraminal height (LFH) changes during right rotation (RR) compared with neutral position (N), (b) Right foraminal height (RFH) and left foraminal height (LFH) changes during left rotation (LR) compared with neutral position (N).

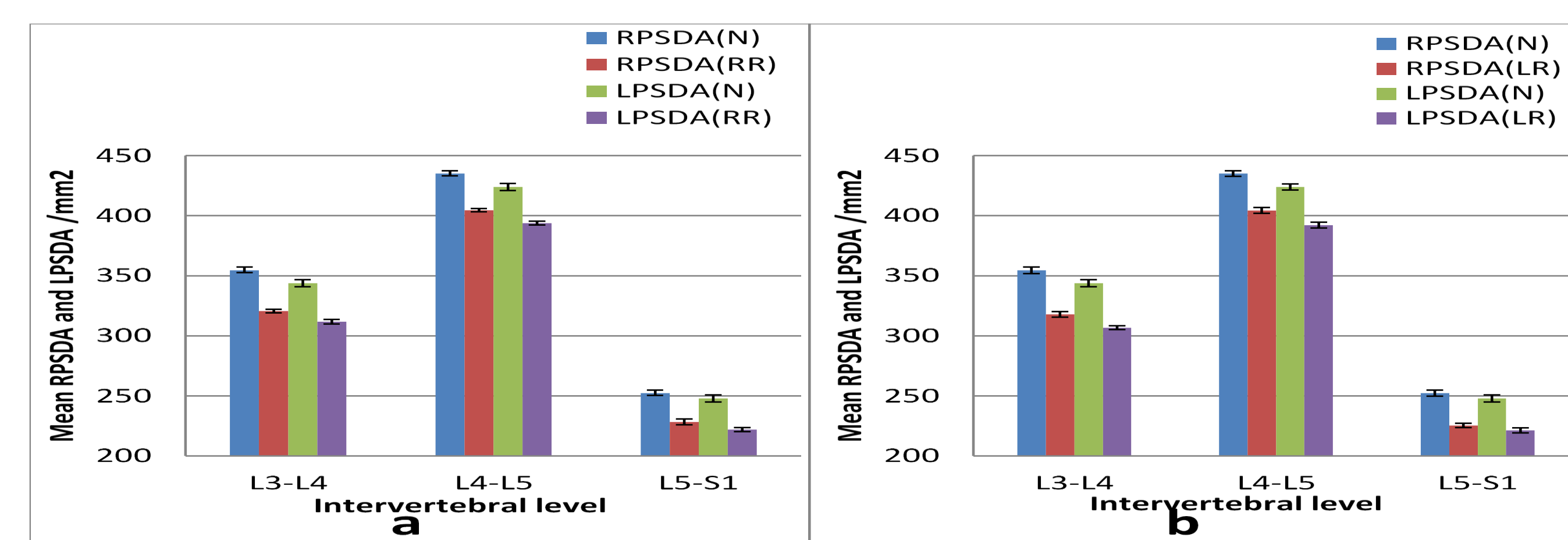


Fig. 5 (a) Right parasagittal disc area (RPSDA) and left parasagittal disc area (LPSDA) changes during right rotation (RR) compared with neutral position (N), (b) Right parasagittal disc area (RPSDA) and left parasagittal disc area (LPSDA) changes during left rotation (LR) compared with neutral position (N).

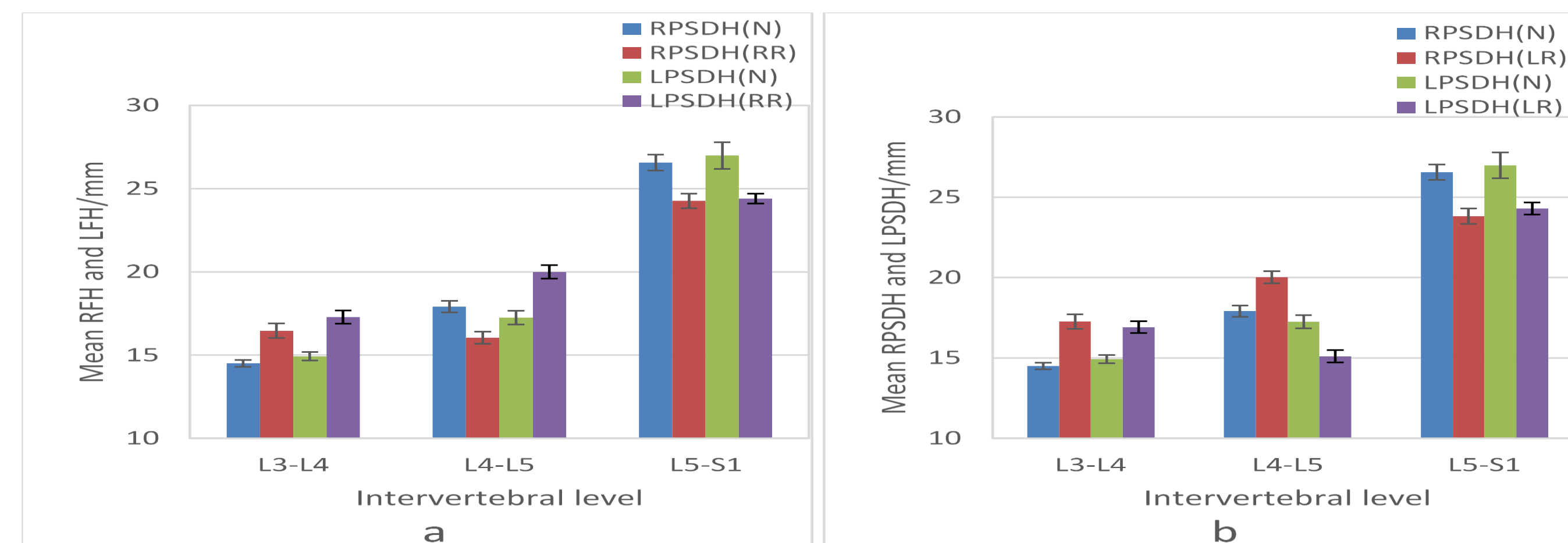


Fig. 6 (a) Right parasagittal disc height and Left parasagittal disc height (LPSDH) changes during right rotation (RR) and left rotation (LR) compared with neutral position (N), (b) Right parasagittal disc height (RPSDH) and left parasagittal disc height (LPSDH) changes during right rotation (RR) and left rotation (LR) compared with neutral position (N).

Summary

IVL	LFA	RFA	LPSDA	RPSDA	MSDA
L3-L4					
To Rotated Side	↓	↓	↓	↓	↓
L3-L4					
Opposite Side	↑	↑	↓	↓	↓
L4-L5					
To Rotated Side	↓	↓	↓	↓	↓
L4-L5					
Opposite Side	↑	↑	↓	↓	↓
L5-S1					
To Rotated Side	↑	↑	↓	↓	↓
L5-S1					
Opposite Side	↓	↓	↓	↓	↓

Fig. 7 IVL=intervertebral level, LFA=left foramen area, RFA= right foramen area, LPSDA=left parasagittal disc area RPSDA= right parasagittal disc area, MSDA=mid sagittal disc area, ↑increased in value, ↓ decrease in value.

CONCLUSION

Rotation of the lower trunk caused morphologic changes in the IVD and IVFs.

This provides normal variant data and could help explain the treatment benefits of manipulation therapy in spinal conditions.