



Original Article

Variability in the size of the retroperitoneal oblique corridor: A magnetic resonance imaging-based analysis

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ABSTRACT

Background: A minimally invasive approach to the L2-S1 disc spaces through a single, left-sided, retroperitoneal oblique corridor has been previously described. However, the size of this corridor varies, limiting access to the disc space in certain patients. Here, the authors retrospectively reviewed lumbar spine magnetic resonance imaging (MRI) in 300 patients to better define the size and variability of the retroperitoneal oblique corridor.

Methods: Lumbar spine MRI from 300 patients was reviewed. The size of the retroperitoneal oblique corridor from L2-S1 was measured. It was defined as the (1) distance between the medial aspect of the aorta and the lateral aspect of the psoas muscle from L2-L5 and (2) the distance between the midpoint of the L5-S1 disc and the medial aspect of the nearest major vessel on the left at L5-S1. In addition, the rostral-caudal location of the iliac bifurcation was measured.

Results: The size of the retroperitoneal oblique corridor at L2/3, L3/4, L4/5, and L5/S1 was, respectively, 17.3 ± 6.4 mm, 16.2 ± 6.3 mm, 14.8 ± 7.8 mm, and 13.0 ± 8.3 mm. The incidence of corridor size <1 cm at L2/3, L3/4, L4/5, and L5/S1 was 10.3%, 16.0%, 30.0%, and 39.3%, respectively. The iliac bifurcation was most commonly found behind the L4 vertebral body ($n = 158, 52.67\%$) followed by the L4/5 disc space ($n = 74, 24.67\%$).

Conclusion: The size of the retroperitoneal oblique corridor diminishes in a rostral-caudal direction, often limiting access to the L4/5 and L5/S1 disc spaces.

Keywords: Fusion, Lumbar interbody fusion, Magnetic resonance imaging, Minimally invasive surgical, Oblique lumbar interbody fusion

INTRODUCTION

The objective of this magnetic resonance (MR) morphometric study is to better characterize the oblique corridor between the vasculature and psoas muscle in neurosurgical patients undergoing lateral lumbar interbody fusion (LIF), anterior retroperitoneal transpsoas approach, and oblique lumbar interbody fusion (OLIF). Lateral LIF (LLIF) may be performed through an anterior or posterior approach or minimally invasively.

The anterior retroperitoneal transpsoas approach is another alternative but is associated with an 18% complication rate attributed to plexus injuries, sensory deficits, motor deficits, and anterior

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thigh pain.^[3,4] The anterior retroperitoneal OLIF, another minimally invasive technique, avoids the lumbar plexus, but the corridor between the vasculature and psoas muscle can be variable and limiting.

MATERIALS AND METHODS

The study was undertaken with the approval of the Institutional Review Board of our hospital. We retrospectively reviewed 300 consecutive MR imaging (MRI) studies (slice thickness of 3 mm) from 2013 to 2015. The following variables were studied: age, sex, and location of the iliac bifurcation (defined as the first disc or vertebral body where two independent iliac vessels could be discerned on axial imaging) [Figure 1]. Most critically, the oblique working corridor, defined as the distance between the lateral border of the aorta or common iliac vessel and the medial border of the left psoas, was recorded in each case at the L2/3, L3/4, and L4/5 disc levels [Figure 2]. At L5/S1, the distance from the midpoint of the intervertebral disc to the closest vascular structure was measured and recorded (e.g., oblique working corridor at L5/S1) [Figure 3].

Statistical analysis

All MR measurements were taken from axial T2-weighted MR images and reviewed independently by three neurosurgery residents. One-way analysis of variation (ANOVA) to compare the size of the oblique working corridor at L2/3, L3/4, and L4/5 levels was performed.

RESULTS

The 300 patients included 136 men and 164 women, averaging, 63 ± 14.2 years.

Size of oblique working corridor

The size of the oblique working corridor decreased in size from L2/3 to L5/S1. The size of the oblique working corridor at L2/3, L3/4, L4/5, and L5/S1 was 17.3 ± 6.4 mm, 16.2 ± 6.3 mm, 14.8 ± 7.8 cm, and 13.0 ± 8.3 mm, respectively [Table 1]. The percentage of an oblique working corridor sizes <1 cm at L2/3, L3/4, L4/5, and L5/S1 levels was 10.3%, 16.0%, 30.0%, and 39.3%, respectively.

Level of aortic bifurcation

The level of the aortic bifurcation was most commonly found at the L4 vertebral body (158 patients, 52.67%). The second and third most common levels for the aortic bifurcation were the L4/5 intervertebral disc (74 patients, 24.67%) and L5 vertebral body (40 patients, 13.33%) [Table 2].

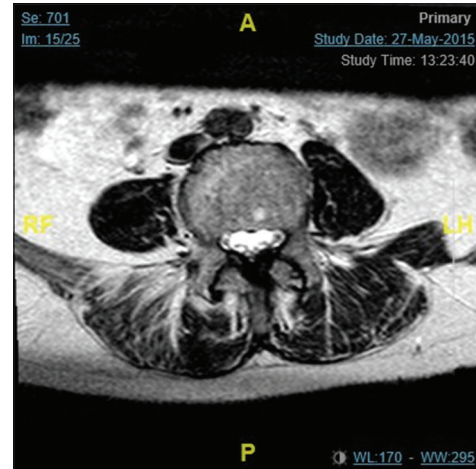


Figure 1: Axial magnetic resonance T2 sequence image demonstrating the bifurcation of the aorta into two iliac arteries. This landmark can be used to select the appropriate approach to the anterior spine.

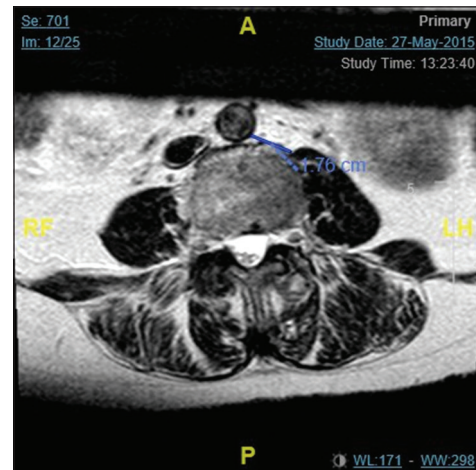


Figure 2: Axial magnetic resonance T2 sequence image depicting the oblique working corridor between the aorta and psoas muscle. When narrow, this space can be expanded by retracting the anterior psoas muscle posteriorly.

Table 1: The size of the oblique corridor was measured from L2-S1 and found to decrease in the caudal direction. A value of 0 was noted in the cases in which a vessel covered the entire corridor.

Level	Size of corridor	SD	Minimum	Maximum
L2/3	17.3	6.4	0	43.2
L3/4	16.2	6.3	2.4	37.9
L4/5	14.8	7.8	0	43.4
L5/S1	13	8.3	0	32.1

Statistical analysis

Utilizing the one-way ANOVA analysis to compare the size of the oblique working corridor, we found a significant

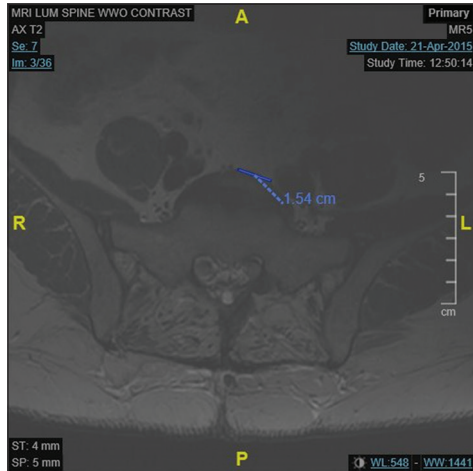


Figure 3: Axial magnetic resonance T2 sequence image demonstrating the corridor at L5-S1. The midpoint of the intervertebral disc was measured to the nearest vessel, in this case, the left iliac vein.

Table 2: The level of the aortic bifurcation was most commonly found at the L4 vertebral body.

Bifurcation level	Number of patients	Percentage of cohort
L3	6	2.00
L3/4	22	7.33
L4	158	52.67
L4/5	74	24.67
L5	40	13.33
L5/S1	0	0.00
Total	300	100.00

difference in the size of the oblique working corridor at $P < 0.05$ level for each of the three levels (L2-L3, L3-L4, and L4-L5) ($F[2, 897] = 10.02, P = 0.00005$). *Post hoc* analysis in the form of Tukey honestly significant difference test demonstrated a significant difference in the size of the corridor between L2/3-L4/5 and L3/4-L4/5 at $P < 0.05$ level. There was no significant difference between L2/3 and L3/4.

DISCUSSION

The LLIF has gained in popularity but is not without its own set of complications, such as 28.5% of patients experiencing hip flexor weakness in one study,^[8] 36.07% of patients with transient neurological injury, and 3.98% of patients with persistent neurological injury. The rates of femoral nerve palsies are relatively low; one retrospective review found it present in 2.6% of 230 patients.^[1] Rates of visceral and vascular injuries are also low in LLIFs.^[7]

OLIF has similar benefits to the LLIF without the need to traverse the psoas muscles. Here, the oblique working corridor can be increased in size by sweeping the psoas

muscle posteriorly. Woods *et al.*^[9] found that the corridor can be dilated up to 26 mm. We found that the corridor decreases in size from L2/3 to L4/5, a finding corroborated by prior MRI studies. Of interest, the corridor is smallest at L4/5 (15 mm), and this space can easily be dilated to accommodate all instruments needed to complete a discectomy and place an interbody graft.^[6]

Major complications include vasculature injury due to the more anterior trajectory compared to the LLIF. Woods *et al.*^[9] reported 2.9% rate of vascular complication, all occurring at the L5/S1 level. Ureter injury and ventral dural tear have also been reported.^[2,5] A large retrospective chart review found decreased rates of sensory changes and psoas weakness with OLIF versus LLIF.^[4]

CONCLUSION

The OLIF fusion utilizes a natural corridor that exists between abdominal vasculature and the psoas muscle and avoids the lumbar plexus injuries seen with LLIF. MRI should be utilized to determine the size of the OLIF working corridor and to assess whether LLIF can be safely and effectively performed.

Declaration of patient consent

Patient consent not required as patients identity is not disclosed or compromised.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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