

# MAPPING OF L4 ROOT'S EXTRAFORAMINAL PATH AT THE INTERTRANSVERSAL SPACE L4-L5 THROUGH PARAMEDIAN PORT TO SPINE

MAURO EMILIO CONFORTO GRACITELLI<sup>1</sup>, DANILO RICARDO OKISHI DE OLIVEIRA<sup>1</sup>, HENRIQUE MENNUCCI DE HAIDAR JORGE<sup>1</sup>, MARCELO PODEROSO DE ARAÚJO<sup>2</sup>, TARCÍSIO ELOY PESSOA DE BARROS FILHO<sup>3</sup>, REGINALDO PERILO OLIVEIRA<sup>4</sup>, ALEXANDRE SADAO IUTAKA<sup>5</sup>, ALEXANDRE FOGAÇA CRISTANTE<sup>5</sup>, DOUGLAS KENJI NARAZAKI<sup>6</sup>, LEONARDO DOS SANTOS CORREIA<sup>6</sup>

## SUMMARY

End-lateral disc hernias account for 10% of the symptomatic disc hernias, most commonly localized at L3-L4 and L4-L5 levels. For many years, the surgical treatment of foraminal and extraforaminal lumbar hernias was made through median posterior port by hemilaminectomy and total or partial facetectomy. A number of variations to this technique have been proposed in order to avoid facetectomy and its biomechanical effects, which sometimes cause the onset of low lumbar pain as a result of vertebral instability. The surgical treatment of this pathology through paramedian port, between multifidus and longissimus muscles (Wiltse port), has the advantage of sparing the patient from bone losses

and of allowing a more oblique view of the neuroforamen. This port enables, with a minimal L4 root movement, access to L4-L5 disc and its occasional extraforaminal hernias. Our objective is to present a study of the extraforaminal path of L4 root at the intertransversal space L4-L5. For this purpose, 10 cadavers (20 sides) have been dissected for obtaining measurements based on 6 anatomical parameters. Data analysis enables us to conclude that end-lateral disc hernias at L4-L5 level may be accessed with a relative safety through paramedian port.

**Keywords:** Intervertebral disc displacement; Radiculopathy; Low back pain; Spinal cord; Laminectomy; Sciatic neuropathy.

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## INTRODUCTION

Knowing the anatomical arrangement of a nervous root in its extraforaminal path is important in several situations, either resulting from a need to directly access a root, or other structures adjacent to it.

Its relative importance for lumbar spine is even more evident when addressing one of the most common affections of the axial skeleton: disc hernia. Among its possible locations, the end-lateral disc hernia causing compression to the nerve root next to intervertebral foramen is a common variable, however not less considerable.

Although most of the disc hernias may be accessed by a median port, a surgeon must be familiar to paramedian port and to the topography of anatomical structures found in it in order to reduce the risk of inherent iatrogenic injuries when this is required<sup>(1)</sup>. And, in considering this issue, the authors proposed a careful study of the L4 root's extraforaminal path at intertransversal L4-L5 space.

## MATERIALS AND METHODS

### Anatomic evaluation

For conducting this study, 10 cadavers (20 sides) were used, which were sourced by the São Paulo City Death Examination Service (SVOC) of the University of São Paulo, randomly selected. The extraforaminal path at intertransversal L4-L5 path of the fourth lumbar root was exposed and mapped.

### Inclusion criteria:

a - age above 18 years old (when skeletal maturity is completed);

### Exclusion criteria:

a - bone deformities on dorsal lumbar segment, visible after placing the cadaver at ventral decubitus;  
b - skin scars on lumbar region suggesting previous spinal surgery;

Study conducted at the Orthopaedics and Traumatology Institute, Medical School, University of São Paulo.

Correspondences to: Marcelo Poderoso de Araújo, R. Oscar Freire, 1218, ap123, Jardins, São Paulo, SP. CEP: 01426-000; e-mail: [ortopoderoso@yahoo.com.br](mailto:ortopoderoso@yahoo.com.br).

1. Resident doctor at IOT-HCFMUSP

2. Preceptor doctor at IOT-HCFMUSP

3. Chairman of IOT-HCFMUSP

4. Head of Spine Group, IOT-HCFMUSP

5. Assistant doctor, Spine Group, IOT-HCFMUSP

6. Resident doctor, Spine Group, IOT-HCFMUSP

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c - vertebral malformations noticed during dissection;  
 d - fractures of transverse processes or other relevant bone protuberances revealed during dissection;

### Access port

The cadaver was positioned at ventral decubitus. A paramedian longitudinal access port (3cm lateral to median line) approximately 8 cm long, having as a reference point the cadaver's iliac crest (level L4-L5) with 4 cm proximal and 4 cm caudal to this anatomic parameter. The level was confirmed by means of palpation of the inter-spinous intervals from S1 spinous apophysis (first sacral vertebra). The intertransversal L4-L5 space was addressed through the plane between multifid and longissimus muscles (Wiltse's port). The muscles and intertransversal membrane at the same level were removed for exposing L4's root (Figure 1).

### Mapping

Measurements were performed using a rule and a millimeter pachymeter (Figure 2). The following parameters were measured and used (Figure 3):  
 1 - L4's root length at intertransversal L4-L5 space;  
 2 - L5 transverse process length;  
 3 - Distance between L5 transverse process base and the point where L4 root crosses it;  
 4 - Distance between L4 root proximal emergence and L5 transverse process base.  
 5 - L4 root depth in its emergence.  
 6 - L4 root depth when crossing L5 transverse process.

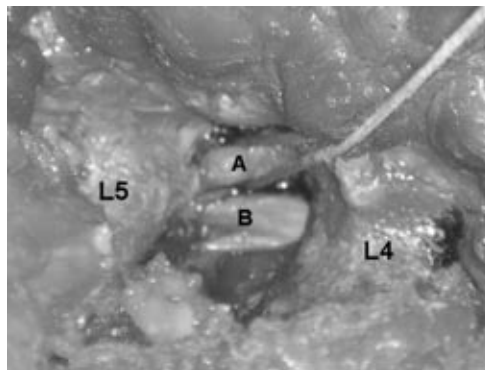
### RESULTS

Measurements were assessed and recorded for each dissected root as shown on Table 1. From measurements obtained, we determined the following results for each parameter: maximum value, minimum value, average, median, and standard deviation (Table 2).

Clinical criteria supplied by SVOC have also been recorded.

### DISCUSSION

It is estimated that approximately 10%

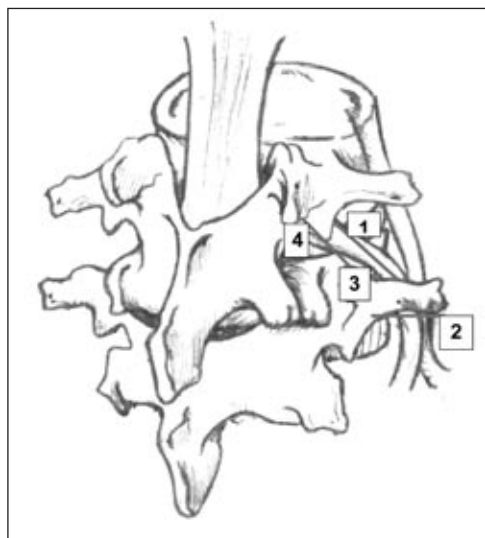


Label: L4: L4 transverse process; L5: L5 transverse process; A: L4 Root; B: L3 Root.

Figure 1 – Wiltse's port. Final appearance of dissection.



Figure 2 – Material used for mapping.



Label: 1 - L4 root length at L4-L5 intertransversal space; 2 - L5 transverse process length; 3 - Distance between L5 transverse process base and the point where L4 root crosses it; 4 - Distance between L4 root proximal emergence and L5 transverse process base.

Figure 3 – Measured anatomical parameters.

of all symptomatic disc hernias are end-lateral variants. Most commonly located at levels L4-L5 and L3-L4, these affect a patient population within a more advanced age group than posterolateral hernias<sup>(2,3,4,5)</sup>.

As a corollary to its medial-lumbar location or even at higher levels, patients with sensitive changes on thigh's anterior surface, quadricipital paresis, femoral nerve's passive strain test positivism, or abolished patellar reflex must be investigated because of their potential to present with extraforaminal disc hernia. Pain may also be more severe than the one experienced with posterolateral hernia due to its location and compression of the sensitive root ganglion<sup>(6)</sup>.

Once a discectomy surgery is indicated, we enter in another dilemma: how to address this hernia? There are some surgical access possibilities to extraforaminal hernias, each one with its advantages and disadvantages. For many years, the surgical approach to foraminal and extraforaminal lumbar hernias was made through median access port followed by a total hemilaminectomy at the level addressed<sup>(7,8,9)</sup>. Despite of the good root and hernia visualization achieved with this method, the emergence of low lumbar pain is frequent due to vertebral instability created. Numerous variations were proposed for this technique in order to avoid facetectomy and its biomechanical repercussions. Despite of the attempts, the "iatrogenic lumbalgia" remained as one of the significant concerns on postoperative evolution of those patients. The need to reduce per-operative damages to bone frame and to paravertebral muscles has led to the development of access ports and minimally invasive and less traumatic discectomy techniques. The paramedian port, following the plane between multifid and longissimus muscles<sup>(10,11,12,13)</sup> has the advantage of sparing the patient from bone losses, as in cases of laminotomies and facetectomies, as well as of enabling a more oblique view of the neuroforamen. Its versatility is more notorious at lower levels (L4-L5, L5-S1), where the end-lateral hernia is even less accessible through median port than it is at

other levels <sup>(4,14)</sup>. Clinical studies such as the one by Bradley and cols.<sup>(15)</sup> confirmed good results with the use of paraspinal port for treating end-lateral lumbar disc hernia, with up to 85% of their patients showing relative satisfaction regarding quality of life and resolution of the painful picture. Poor surgical familiarity, deep dissection, poor visualization, difficulties in enucleating intervertebral disc, and the potential risk of injury to emergent nervous root are some of its disadvantages. Although scarce, studies comparing techniques evidenced better results when the transmuscular lateral port was performed for extraforaminal discectomy <sup>(16)</sup>. Once the intertransversal L4-L5 space is reached and the intertransversal membrane is res-

**Table 1 – Anatomical Results.**

N	Sex	Clinical Parameters				Anatomical Parameters					
		Age (years)	Weight	Height	Side	1 (mm)	2 (mm)	3 (mm)	4 (mm)	5 (mm)	6 (mm)
1	M	51	67	170	RIGHT	17	14	6	18	6	5
					LEFT	19	15	5	19	6	5
2	M	40	73	180	RIGHT	15	17	6	17	4	5
					LEFT	16	18	6	16	4	4
3	M	46	70	180	RIGHT	16	17	5	17	4	5
					LEFT	17	17	4	20	5	5
4	M	54	65	180	RIGHT	18	20	9	19	5	5
					LEFT	18	22	6	18	5	5
5	M	83	60	165	RIGHT	17	13	9	14	6	4
					LEFT	15	14	7	15	6	6
6	F	39	60	170	RIGHT	20	14	5	19	5	7
					LEFT	19	14	5	18	7	6
7	M	44	70	170	RIGHT	19	20	4	20	6	5
					LEFT	20	19	5	19	5	6
8	M	80	36	170	RIGHT	17	18	6	19	6	5
					LEFT	17	20	6	18	5	5
9	F	61	75	170	RIGHT	13	20	6	15	5	9
					LEFT	15	20	6	15	5	9
10	M	32	65	180	RIGHT	27	20	7	28	6	6
					LEFT	27	20	7	26	6	5

**Table 2. Descriptive statistical analysis.**

Statistics	Clinical Parameters			Anatomical Parameters					
	Age	Weight	Height	1 (mm)	2 (mm)	3 (mm)	4 (mm)	5 (mm)	6 (mm)
Average	53	64,1	173,5	18,1	17,79	6,0	18,5	5,32	5,6
Median	48,5	66	170	17	18	6,0	18	5,5	5,0
Standard deviation	16,23	10,49	5,5	3,45	2,68	1,37	3,32	1,28	0,82
Maximum	83	75	180	27	22	9	28	10	7
Minimum	32	36	165	13	13	4	14	4	4

**Labels of Figures 1 and 2:**

- 1 - L4 root length at L4-L5 intertransversal space;
- 2 - L5 transverse process length;
- 3 - Distance between L5 transverse process base and the point where L4 root crosses it;
- 4 - Distance between L4 root proximal emergence and L5 transverse process base;
- 5 - L4 root depth in its emergence;
- 6 - L4 root depth when crossing L5 transverse process.

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sected, we see two adjacent roots: L3 (laterally) and L4 (medially), already inside Major Psoas muscle core. This approach enables, with a minimum L4 root mobilization, the access to L4-L5 disc and potential extraforaminal hernias in it. Despite of safety and morbidity considerations, many surgeons still use the “anatomically familiar” posterior-median access with hemilaminectomy and total or partial facetectomy <sup>(16)</sup>.

**CONCLUSION**

Measurements achieved regarding topographic positioning of L4 root confirm the potential to access end-lateral disc hernias at L4-L5 level through a paramedian port with relative safety. Furthermore, it involves less morbidity when compared to medial access for the same purpose.

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