

## Measurement of the Lumbar Spine Canal in CT-Scan Malagasy Population

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### Abstract

**Introduction:** Knowing the normal values of the lumbar canal is necessary to evaluate stenosis of the spinal canal. The scanner still holds a place in the exploration of the spine and especially in the exploration of narrowness or narrowing of the canal.

**Objective:** To determine the average and extreme normal values of the lumbar canal in the Malagasy community.

**Methods:** Prospective, descriptive and analytical study from the beginning of March 2016 to the end of September 2016, carried out at the Radiology Department of Morafeno Toamasina University Hospital and the polyclinic of Saint Francis of Assisi Ankadifotsy Antananarivo Madagascar. Study carried out on 67 patients.

**Results:** The mean values of the measurements are respectively expressed in L1, L2, L3, L4 and L5. The anteroposterior canal diameter was 16.33 mm; 15.61 mm; 14.79 mm; 14.48 mm and 15.09 mm. The inter pedicle diameter was 20.83 mm; 20.79 mm; 21.9 mm; 23.16 mm and 24.95 mm. The inter-articular diameter was 17.3 mm; 17.69 mm; 18.83 mm; 20.79 mm and 23.91 mm.

No correlation was found between canal diameters and age, weight and height. Differences in measurement were noted with respect to gender and compared to other populations.

**Conclusion:** Figure 3 comparison of anteroposterior diameter of the lumbar canal by gender.

**Keywords:** Lumbar canal; Biometry; CT

### Abbreviations

CT: Computed Tomography; DAP: Anteroposterior Diameter; DIP: Inter-Pedicle Diameter; DIA: Interarticular Diameter; L1: First Lumbar Vertebra; L2: Second Lumbar Vertebra; L3: Third Lumbar Vertebra; L4: Fourth Lumbar Vertebra; L5: Fifth Lumbar Vertebra

### Introduction

Knowledge of the normal values of the lumbar canal is necessary to evaluate spinal abnormalities and essentially stenoses of the spinal canal [1]. It is also essential for spinal surgery and for surgical implants, especially for pedicle screws [2].

Computed tomography (CT) still has a place in the evaluation of the lumbar canal and in particular ductal stenosis [3].

In everyday practice we rely on the reference values of foreign countries. In Madagascar, to our knowledge, no study has yet been done on the biometry of the lumbar canal.

Thus, we carried out this study to determine the normal and reference values of the lumbar canal in tomodensitometry in Malagasy.

### Materials and Methods

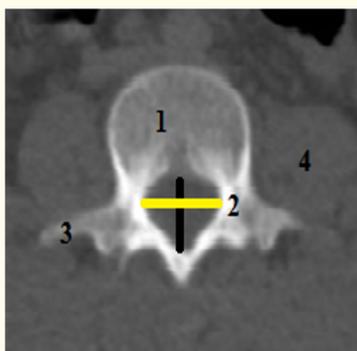
This is a prospective, descriptive study carried out over a six-month period, from the beginning of March 2016 to the end of September 2016. Patient recruitment was carried out at the Saint François Radiology Center. Assisi Antananarivo and at the University Hospital Morafeno Toamasina Madagascar.

Included in this study were all patients who had a CT scan (abdominal, abdominopelvic) to analyze the lumbar spine.

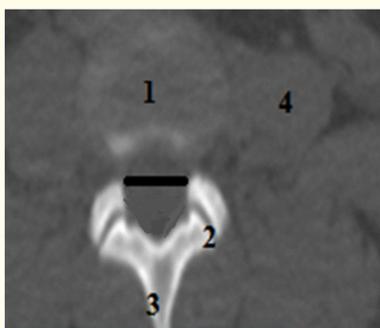
We excluded all patients referred for low back pain and patients with neurogenic claudications of the lower limbs. We also excluded patients with marked degenerative lesions at the lumbar vertebrae. Patients with a history of trauma to the lumbar spine have also been excluded.

Inter-pedicular distances (IPD), anteroposterior diameters (APD), and inter-articular diameters (IAD) were the diameters measured.

These measurements were performed on specific sections: a pediculo-lamary section for DAP and DIP measurements (Figure 1). A section passing through the so-called “disc cutter” for measuring the DIA (Figure 2).



**Figure 1:** *Pediculo-lamaire cut: measurement of DAP (black line) and DIP (yellow line).  
Vertebral body (1); pedicle (2); transverse process (3); psoas (4).*



**Figure 2:** *Axial cut in the bony window passing through the intervertebral disk (1): measurement of the DIA (black arrow).  
Zygapophyseal joint (2); spinous process (3); psoas (4).*

**Results**

Thirty-eight out of 67 of us patients were female with a sex ratio of 1.3. The subjects are aged 20 to 74 years with an average age of 51.3 years for a median of 52 years.

Tables 1-3 show the biometric characteristics of the lumbar canal in Malagasy.

Vertebrae	Min-Max Value	Average	Standard deviation
L1	13 - 19	16	1,5
L2	13 - 19,1	15,61	1,5
L3	11,2 - 18,2	14,48	1,38
L4	12,3 - 17,6	14,79	1,67
L5	11,4 - 20,1	15,09	2,1

**Table 1:** Biometric characteristics of the anteroposterior diameter of the lumbar canal in «millimeters».

Vertebrae	Min-Max Value	Average	Standard deviation
L1	17,8 - 25,9	20,8	2,08
L2	18,2 - 24,9	20,79	1,85
L3	19,4 - 25,7	21,9	1,8
L4	19,9 - 31,7	23,16	2,4
L5	19,6 - 34,4	24,95	3

**Table 2:** Biometric characteristics of inter-pedicle diameter in millimeters.

Vertebrae	Min-Max Value	Average	Standard Deviation
L1	14,3 - 23	17,3	1,7
L2	14,4 - 21,9	17,69	1,74
L3	14,6 - 29,7	18,83	2,6
L4	16,8 - 25,6	20,79	2,1
L5	12,2 - 32	23,91	3

**Table 3:** Biometric characteristics of inter-articular diameter in millimeters.

The broadest mean DAP was localized at L1 (16 +/- 1.5 mm) and the narrowest at L3 (14.48 +/- 1.6 mm). DAP was larger in women than in men (Figure 3). There were differences in measurement between the DAP in our study and those of the other populations (Table 4).

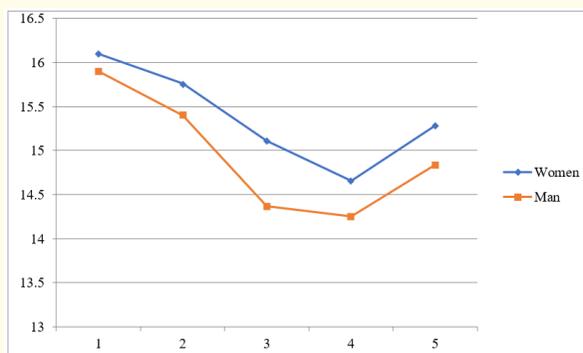


Figure 3: Comparison of anteroposterior diameter of the lumbar canal by gender.

	Malagasy	Italiens	Black Africa	Egyptians	Koreans
L1	16,3 (+/- 1,5)	18,7 (+/-2)	16,6	16,76	15,4
L2	15,61 (+/-1,5)	17,9 (+/-2)	15,8	15,8	14,3
L3	14,79 (+/-1, 38)	16,9 (+/-2)	14,09	15,09	13,6
L4	14,48 (+/-1, 67)	16,9 (+/-2, 1)	15,6	15,4	14
L5	15,09 (+/-2, 1)	17,3 (+/-2, 4)	16	16,3	14,6
p		0,95	0,82	0,82	0,90

Table 4: Comparison of anteroposterior diameter measurements (in mm) in Malagasy with those of other populations: the difference was not statistically significant

Regarding the DIP, it increases gradually from L1 to L5 level with dimensions ranging from 20.83 +/- 2.08 mm to 24.95 +/- 3 mm.

For the DIA, the narrowest value is located at L1 measuring 17.3 mm +/- 1.7 and gradually increasing to 23.91 mm +/- 3 at L5.

The comparison of canal diameters with anthropometric parameters did not find any significant correlation.

### Discussion

In our study, the average of the widest DAP of the lumbar canal is located at the level of L1. This result is consistent with the results of Shruki [4] and Tarek. This could be explained by the bulge of the medullary cone at this level. On the other hand, the average of the narrowest DAP is at the level of L3. This finding has been found by several authors [2,5].

DAP was larger in women than in men in our study. However, the difference is not statistically significant except at the L3 level. These results are consistent with those found by Elhassan and All [6]. Janjua, *et al.* [7] also noted a similar DAP for both sexes. But other authors have found that the diameter of the lumbar canal in men is greater than in women [4,8]. These results can be explained by the difference in morphotype and number of populations studied.

We also compared the DAP with those of other populations (Table 4). The DAP in our study was lower than among Italians [9], Egyptians [2] and black Africans [10]. On the other hand, it was wider than the Koreans [11]. This reinforces Lee’s conclusion on the influence of race on canal diameters. But note that its differences were not statistically significant.

	Malagasy	Italiens	Black Africa	Egyptians	Koreans
L1	16,3 (+/- 1,5)	18,7 (+/-2)	16,6	16,76	15,4
L2	15,61 (+/-1,5)	17,9 (+/-2)	15,8	15,8	14,3
L3	14,79 (+/-1, 38)	16,9 (+/-2)	14,09	15,09	13,6
L4	14,48 (+/-1, 67)	16,9 (+/-2, 1)	15,6	15,4	14
L5	15,09 (+/-2, 1)	17,3 (+/-2, 4)	16	16,3	14,6
p		0,95	0,82	0,82	0,90

**Table 4:** Comparison of anteroposterior diameter measurements (in mm) in Malagasy with those of other populations: the difference was not statistically significant

Concerning the DIP and the DIA, they increase gradually from L1 to the level of L5. The largest diameter was localized at L5 and the narrowest was localized at L1. These results are consistent with the study done by Tarek [2]. On the other hand, El-Rakhawy [5] noted a larger DIP at L5 and narrower at L3 (Table 5).

	Malagasy	Tariq., et al.	Al-Rakhawi., et al.
L1	20,8	23,8	21,6
L2	20,79	24,3	22,5
L3	21,09	25, 72	21,4
L4	23,16	27, 29	23,5
L5	24,95	31,46	24,1

**Table 5:** Comparison of inter-pedicle diameter measurements (in mm) among Malagasy people with those of other populations.

This study did not find a statistically significant correlation for canal diameters and anthropometric parameters. However, M Midia [12] found a correlation with the weight of the subjects and the DIA of L3/L4. A correlation with height and DIP was found by Gouzien [13] at L4 and L5 and by Karantanas [14] at the last three vertebrae.

For the concept of duct narrowing in CT, which is defined by a DAP less than 12 mm [15] and by DIA less than 15 mm. In this study, the lowest average DAP was 14.48 mm, localized at L3. The DIAs all exceeded 15 mm. It can therefore be considered that its limit values could be applied for the Malagasy population [16].

## Conclusion

The scanner still has a place in the evaluation of spinal stenosis. It measures the different lumbar canal diameters. This study made it possible to determine the normal diameters of the lumbar canal in asymptomatic Malagasy populations. These measures could serve as a useful basis in our daily practice.

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