PARAMETERS OF NUCLEAR MAGNETIC RESONANCE IN PATIENTS WITH CONGENITAL NARROWING OF THE LUMBAR SPINAL CANAL

OBJECTIVE
To compare the morphological parameters of magnetic resonance in patients with congenital narrowing of the lumbar spinal canal with patients with low back pain.

METHODS
A descriptive, retrospective, observational study was conducted with measurements in the axial and sagittal magnetic resonance sections of the vertebral body and canal of the lumbar spine of 64 patients with diagnosis of low back pain, which were compared with images taken from 31 Mexican patients with congenital narrowing of the lumbar spinal canal. Results: The results show that patients with congenital narrowing of the lumbar spinal canal in the axial sections have a difference in diameters, being L2 < 13.9 mm, L3 < 13.3 mm, L4 < 12.9 mm, L5 < 13.1 mm, compared with controls L2 < 20.5 mm, L3 < 20.5 mm, L4 < 19.3 mm, L5 < 18.1 mm with p = 0.000. Conclusions: We found different measurements in the Mexican population compared to those found by similar studies. With the parameters obtained, it would be possible to make the proper diagnosis, surgical planning, and treatment.

Keywords: Low back pain; Magnetic resonance imaging; Lumbar vertebrae; Spinal stenosis; Anthropometry.

INTRODUCTION
Spinal stenosis is a disorder that generates nerve compression in the spinal canal. One of the first descriptions was published by Arnoldi et al., who defined the pathology as any narrowing of the spinal canal, of the nerve roots, or of the vertebral foramen. Spinal stenosis has been associated with various genetic changes, such as mutations in the COL9a2 gene, Trp2 and Trp3, which suggests that there are genetic factors that play an important role in the pathogenesis of this illness. These findings suggest that there is a genetic predisposition similar to that which occurs in intervertebral disc degeneration. In a 2009 study by Kalichman et al., the prevalence of congenital and acquired lumbar stenosis was evaluated radiographically in 191 individuals, averaging 52.6 years of age and with an average BMI of 27.8.
who had suffered at least one month of low back pain within a one year timeframe. Absolute congenital lumbar stenosis was observed in 2.6% of the population and acquired lumbar stenosis in 22% of the population, with no significant difference in terms of the sex of the population.  

One of the main studies to measure the lumbar spinal canal was conducted by Verbiest et al., who proposed that two types of stenosis exist: absolute stenosis, in which the diameter of the spinal canal is less than 10 mm, and relative stenosis, in which the canal measures between 10 and 12 mm in diameter. This study was conducted using intraoperative measurements. This same author conducted a study of the spine using computed axial tomography in which the diameters of the spinal canal in sagittal sections were measured, and he arrived at the conclusion that absolute stenosis is that in which the average sagittal anteroposterior diameter is less than 10 mm and when it is between 10 and 13 mm it is considered to be relative stenosis.

The author of this study refers to congenital stenosis as accounting for from 10 to 15% of all cases of lumbar stenosis. Usually idiopathic in nature, it involves a hypoplasia in the development of the posterior arch along with a shortening of the pedicles and a decrease in the anteroposterior diameter of the spinal canal. The central canal takes the form of a stricture, better evaluated using an axial section. Some other less common causes may involve diseases with developmental changes such as achondroplasia, Morquio syndrome, and several other bone displasias.

Ulrich et al. suggested that an anteroposterior spinal canal diameter of less than 11.5 mm, measured in computed tomography sections, is abnormally small. Lee et al. reported that the sagittal diameter of the spinal canal in the lumbar spine should never be less than 10 mm in a normal spine. Schonstrom et al. introduced the term cross-sectional area of the dural sac, which measures the total area of the dural sac, and defined it as the most reliable measurable diagnostic parameter in lumbar stenosis. In this study, they reported that areas greater than 100 mm² are considered to be normal, cross-sectional areas of the dural sac between 76 and 100 mm² as moderately stenotic, and those less than 76 mm² as severely stenotic.

In 2005, Singh et al. published a prospective study in which they used magnetic resonance imaging of the lumbar spine, as well as conventional lateral radiographs, to take specific measurements in patients diagnosed with congenital lumbar stenosis. In this study, axial sections of the anteroposterior diameter of the spinal cord of healthy patients were compared with those of patients with congenital stenosis, the latter group with a statistically significantly smaller diameter, averaging slightly less than 15 mm. They concluded that patients with congenital stenosis, who have a smaller anteroposterior diameter of the spinal canal, a smaller length of the pedicle, and a smaller cross-sectional area in axial sections than healthy patients, are predisposed to suffer symptoms at an earlier age.

More recent studies, like that by Kitab et al. published in 2014, studied the radiographic anatomical variations through magnetic resonance of the spine in patients with lumbar stenosis who were less than 50 years of age and had presented symptoms for at least two months with neurogenic claudication. In their study, they found certain radiographic parameters in patients who are more likely to develop symptoms of narrowing of the spinal canal at an earlier age.

Today, few studies exist that use imaging to quantitatively evaluate patients younger than 50 years of age and diagnosed with congenital narrow lumbar spine canal, and who had undergone surgical treatment between January, 2014, and December, 2015. The following measurements were taken by two observers: the anteroposterior (AP) distance of the vertebral body in the axial section, the distance between the anterior and posterior cortices of the vertebral body, the width of the vertebral body in the axial section, the distance between the lateral cortices of the vertebral body, the AP distance of the vertebral canal in the axial section, the distance between the anterior and posterior cortices of the vertebral canal, the interfacet distance of the vertebral canal in the axial section, the distance between the anterior and posterior cortices of the vertebral canal, the AP distance of the vertebral canal in the sagittal section, the distance between the posterior cortical bones of the vertebral body, the height of the vertebral body in the sagittal section, the distance between the upper and lower platforms of the vertebral body, the AP distance of the spinal canal in the sagittal section, the distance between the posterior cortical bones of the vertebral body and the anterior cortical bone of the vertebral canal. This study was approved by the Institutional Review Board as registration number R-2016-3401-35.

RESULTS

The average age of the control group was 41.9 years (SD 10.3, ranging from 22-60 years of age) while in the case group it was 42.1 years (SD 4.8, ranging from 28-49 years of age). There were 28 men and 36 women in the control group and 24 men and 7 women in the case group. A Kappa of 98 was used as the interobserver parameter. The results as measured show that the average AP distance of the spinal canal in the axial section in L2 in patients with congenital narrowing of the spinal canal was 13.9 mm (SD ±0.92) as compared to the controls at 20.5 mm (SD ±2.1). In L3, it was 13.3 mm (SD ±0.73) as compared to 20.5 mm (SD ±2.0). In L4, it was 12.9 mm (SD ±0.93) as compared to 19.3 mm (SD ±0.93). In L5, it was 13.1 mm (SD ±1.0) as compared to 18.1 mm (SD ± 2.2).

The comparisons of the measurements taken are shown in Table 1 and Figure 1.

DISCUSSION

In our study, we found that there are variations in magnetic resonance measurements in the Mexican population as compared to other studies. According to Verbiest in the early 50s, the critical values for absolute and relative stenosis are anteroposterior sagittal diameter of the vertebral canal of less than 10 mm and of between 10 mm and 12 mm, respectively. Cheung et al. reported 14.7 mm for L2, 13.8 mm for L3, 13.7 mm for L4, and 14.2 mm for L5. In our results, we found differences in the diameters in the sagittal sections in the Mexican population: 12.3 mm for L2, 11.6 mm for L3, 12 mm for L4, and 12.2 mm for L5.

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and 13.1 mm for L5. A significant difference between populations was found when we compared the measurements of the canal diameter in axial sections of patients without lumbar stenosis in the Chinese population (L2 of 21.9 mm, L3 of 22.4 mm, L4 of 20.2 mm, and L5 of 19.6 m) with the same measures in the Mexican population (L2 of 20.5 mm, L3 of 20.5 mm, L4 of 19.3 mm, and L5 of 16.1 mm).

Among the limitations of the study, we found that the sections of the magnetic resonances were at different levels of the vertebral bodies, but the section most suitable for our study was used. The cross-sectional area of the vertebral canal was not considered because the X-ray system used in the study did not have this function.

CONCLUSIONS

With this study, we can see differences between the measurements in the Mexican population compared to other similar studies with other populations worldwide. With the parameters obtained, we can make an adequate diagnosis, determine the lumbar level to be surgically treated, and identify the patients who are predisposed to suffer the symptoms of lumbar stenosis.

All the authors declare that there are no potential conflicts of interest regarding this article.

REFERENCES