Degenerative disc disease is considered to be a major factor in low back pain. Clinical and experimental studies have linked chronic low back pain with intervertebral disc disease in up to 40% of cases. Discogenic pain can be divided into subgroups, such as herniation, low back pain. Clinical and experimental studies have linked chronic work disabilities, having a large socioeconomic impact.1

INTRODUCTION
Degenerative disc disease is considered to be a major factor in low back pain. Clinical and experimental studies have linked chronic low back pain with intervertebral disc disease in up to 40% of cases. Discogenic pain can be divided into subgroups, such as herniation, low back pain. Clinical and experimental studies have linked chronic work disabilities, having a large socioeconomic impact.1

Kirkaldy-Willis and Farfan classified the degenerative process into 3 phases: the first, called dysfunction, is found in individuals with 15 to 45 years and is characterized by small tears in the annulus fibrosus and the presence of synovitis in the facet joints. In the following phase, the instability, individuals with 35 to 70 years present with internal disc disruption, progressive disc resorption, degeneration of the articular facets with capsular laxity and subluxation. The last phase, the stabilization, occurs around age 60, when osteophyte development around the disc and the facet joints causes segmental stiffness or true ankylosis.4

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Loss of disc height in the lateral radiographs of the spine, osteophyte formation, Schmorl’s node, end plate sclerosis and vacuum sign have been described as signs of late disc degeneration. Intervertebral osteochondrosis is the term used when these radiographic findings are seen together. 

There are several radiographic methods for measuring intervertebral disc height on profile radiographs, such as the Hunthdal method 1 and 2 and the Farfan method. A modification of the latter showed high reliability. (Figure 1) Based on the fact that a non-ideal radiographic angulation could alter the correct measurement of disc height, in their 1997 study, Frobin et al. developed a technique that seeks to correct this possible error by calculating the bisection of the midlines of the adjacent vertebrae. (Figure 2)

The aim of the study was to measure the radiographic height of lumbar intervertebral discs by means of the modified Farfan method and the Frobin method, making inter- and intraobserver comparisons.

MATERIAL AND METHOD

After review and approval of the study by the Research Ethics Committee, radiographic examinations of the patients were selected according to the following criteria: minimum age of 18 years; either sex; history of low back pain already in monitoring and investigation of the comorbidity outpatiently; having performed magnetic resonance imaging (MRI) of the lumbosacral spine; and having signed an informed consent form.

The following were used as exclusion criteria: patients with previous surgical treatment of the spine; radiographic congenital abnormalities such as vertebral malformations; scoliosis greater than 15 degrees; presence of listhesis with more than 20% slip; tumor diseases.

The images were collected from outpatients and measurements were performed later in Image-Pro® Plus version 6.0 software, based on the modified Farfan method and the Frobin method. (Figures 1A-D, 2, 3 and 4)

Two residents in spine surgery, two surgeons with up to 5 years experience (intermediate) and two surgeons with over 5 years experience (senior) calculated the disc height according to the modified Farfan method and the Frobin method, as described in Figures 1A-D and 2. The unit of measurement adopted was the pixel. After a period of three months, a new measurement of the same sample (six patients, 30 discs) was requested in order to identify possible inter- and intraobserver differences.

The results were analyzed using the intraclass correlation coefficient (ICC). Analysis of concordance was performed between methods, among all examiners according to experience, among all examiners and intraexaminer, with their respective 95% confidence intervals.

The ICC is a parametric method to evaluate concordance, ranging from 0 to 1; the closer to 1, the greater the agreement.

The absolute differences using mean and standard deviation were described to measure the difference between the examiners according to experience in the same method.
RESULTS
Upon comparing the agreement between the methods for each examiner, both appear to be similar and reproducible. (Table 1) When intraexaminer analysis was performed, both the modified Farfan method and the Frobin method demonstrated a high intraclass correlation coefficient (ICC), showing that they are effective. (Table 2)

When comparing the agreement between the examiners' level, the higher the experience level, the higher was the agreement in both methods. (Table 3)

DISCUSSION
Several factors determine the complex pathophysiology of disc degeneration, which remains poorly understood. The normal intervertebral disc presents anatomical and biochemical characteristics that allow it to absorb and dissipate the loads transmitted between the segments of the spine. It is composed of three structures: the annulus fibrosus, the nucleus pulposus, and the endplate. The annulus fibrosus is highly organized in 15 to 40 lamellae made of collagen fibers positioned between themselves at a 30° angle. The endplate is composed of hyaline cartilage, which covers the upper and lower surface of the vertebral body, and serves as a biomechanical and metabolic interface with the nucleus pulposus. The nucleus pulposus is composed of delicate networks of well hydrated fibers, with the residual material of the notochord, forming a gelatinous matrix. Type II collagen, proteoglycans, and glycosaminoglycans comprise 10-15% of the healthy nucleus pulposus. Along with 85-90% water, they allow the intervertebral disc to perform its function.

Disc degeneration starts around the third decade of life, with dehydration of the nucleus pulposus and changes in the molecular structures of their components. Thus, there is an increase in the formation of type I collagen and an increase in type II collagen, reducing the content of the latter and the amount of aggrecan in the nucleus pulposus, which affects its ability to retain water and modifies its hydrostatic properties.

In their study comparing changes on radiographies and magnetic resonance imaging of patients with potential degenerative disc disease related to work involving weight lifting, Frobin et al. concluded that the loss of disc height is a late finding in degenerative disc disease, being preceded by the loss of the normal disc signal on MRI, disc prolapse and signal changes in adjacent vertebral endplates. They also observed that postural changes, such as decreased lumbar lordosis, can alter the measurement of disc height, as well as the biotype of the patient, so the assertion that there is a decrease in disc height at a certain level should only be made after a comparison with the patient’s other lumbar discs.

In contrast to the classic findings in the literature, when using the protocol for measurement of disc height described by Frobin et al., we concluded that the disc height increases with age until the seventh decade, a fact explained by the increased concavity of the vertebral endplates with age. After the seventh decade, decreased disc height was justified by the loss of material due to disc herniation or the loss of volume due to dehydration.

It was also shown that the disc height can vary according to time of day, age, and activity performed. In the morning, the disc height tends to be higher than at the end of the day. After performing physical activity with axial loads, the disc height decreases more in the young than in the elderly, since in the latter the disc is more dehydrated and hardened.

In our study, both methods have proved to be reliable and reproducible, with the modified Farfan method showing a slight advantage. Moreover, due to the method having a simpler technique, it was also preferred by the examiners.

The fact that the comparison of the first with the second measurement of each method (Farfan 1 x Farfan 2 and Frobin 1 x Frobin 2)
presented lower agreement than the comparison between the methods in the first measurement (Farfan 1 x Frobin 1) drew our attention. This fact can be explained by the degree of similarity between the methods and by Farfan 1 and Frobin 1 being measured at the same time.

CONCLUSION

Both methods proved to be reliable and reproducible for the measurement of disc height.

The higher the level of experience of the examiner, the higher the agreement in the measurements, demonstrating that more experienced surgeons may be more cautious and accurate at the time of measuring the disc height.

All authors declare no potential conflict of interest concerning this article.

REFERENCES