ABSTRACT

Objective: To assess the incidence of facet effusion in lumbosacral spine magnetic resonance imaging (MRI) and the relationship with radiographic segmental instability in patients submitted to spinal surgery. Methods: Retrospective cohort study of patients submitted to lumbosacral spine surgery over a period of three years, through the evaluation of dynamic radiographs (X-ray) motion and facet effusion in axial section of MRI. Instability was defined as vertebral translation > 3 mm or intervertebral angle > 10°, and facet effusion as fluid in the facet joints > 1.5 mm. Results: The total number of patients that fulfilled the criteria for analysis was 244, of which 47 presented movement (≤ 3 mm) and 31 presented excessive movement (> 3 mm), 115 had facet effusion (≤ 1.5 mm) and 46 presented excessive fluid (> 1.5 mm). Statistical analysis did not demonstrate a significant association between increased segmental movement and facet effusion (p = 0.150). Conclusions: The total incidence of facet effusion was 47.1% and the excessive fluid was 18.9%. There was no association between facet effusion in MRI and instability in dynamic X-ray. MRI does not replace dynamic X-ray in flexion and extension in the evaluations of lumbar instability. Level of evidence III; Retrospective Cohort.

Keywords: Spine; Joint Instability; Spondylolisthesis.

INTRODUCTION

Segmental instability is an important factor that affects the prognosis of spinal surgery and is used by many surgeons as a criterion for fixation and arthrodesis. Segmental instability is an important factor that affects the prognosis of spinal surgery and is used by many surgeons as a criterion for fixation and arthrodesis. Segmental instability is an important factor that affects the prognosis of spinal surgery and is used by many surgeons as a criterion for fixation and arthrodesis. Segmental instability is an important factor that affects the prognosis of spinal surgery and is used by many surgeons as a criterion for fixation and arthrodesis. Segmental instability is an important factor that affects the prognosis of spinal surgery and is used by many surgeons as a criterion for fixation and arthrodesis. Segmental instability is an important factor that affects the prognosis of spinal surgery and is used by many surgeons as a criterion for fixation and arthrodesis. Segmental instability is an important factor that affects the prognosis of spinal surgery and is used by many surgeons as a criterion for fixation and arthrodesis. Segmental instability is an important factor that affects the prognosis of spinal surgery and is used by many surgeons as a criterion for fixation and arthrodesis.
spine, currently more available, has become a routine study in the evaluation of patients with low back pain. This modality provides, among other information, important data about disc degeneration and compression of the neural elements. However, an MRI with the patient in the supine position presents limitations in the evaluation of subtle deformities that appear only when the patient is standing, for example, some cases of vertebral translation.

The presence of hyperintense signals in T2 in the facet joints in MRI axial cuts of the lumbar spine has been being discussed for many years. T2 weightings are used, since, differently from the T1 used in the evaluation of the normal anatomy, T2 weightings show extracellular water as a high-intensity signal. The initial studies observed that these signal alterations were produced by synovial liquid, a result of joint degeneration. However, only recently has facet effusion been associated with instability.

The objective of this study is to evaluate the incidence of facet effusion in MRIs of the lumbosacral spine and its relationship with radiographic segmental instability in patients who have undergone spinal surgery.

**METHODS**

This is a retrospective cohort study of patients who underwent lumbosacral spine surgery at our institution between January 1, 2014 and December 31, 2016. After obtaining approval from the Institutional Review Board (opinion no. 089852/2013), we considered patients for the study who were older than 18 years of age, had undergone surgery in segments L4-L5 and L5-S1, and who had both a dynamic radiograph (X-ray) and MRI of the lumbosacral spine. The exclusion criteria were prior fix action or arthrodesis in the lumbosacral spine, scoliosis defined as >5º at a single level or >10º for the whole curve, dysplasia, infection, neoplasia, fracture, synovial cyst, and X-ray and MRI with more than a year apart. All patients included signed the informed consent form.

For the dynamic X-ray, the patient initially sat on a bench with the soles of the feet flat on the floor and the upper limbs crossed at chest level. The patient was then instructed to bend forward as much as possible for the X-ray in flexion. For the X-ray in extension, performed standing, the patient was asked to perform maximum extension. In previous studies, this dynamic X-ray technique demonstrated optimization of segmental movement of the spine, presenting a high rate of intra- and interobserver concordance.

Movement was evaluated in the lateral incidence of the X-ray. Movement was defined as the anterior translation of the cranial vertebral body over the caudal vertebral body in the sagittal plane. The radiographic measurements were taken using three points of reference: the anterior and posterior extremities of the upper plate of the caudal vertebra and the posterior extremity of the lower plate of the cranial vertebra. A line was drawn connecting the anterior and posterior extremities of the upper vertebral plate of the caudal vertebra. The distance between the two perpendicular lines passing through the posterior extremity of the vertebral body of the upper vertebra and the posterior extremity of the lower vertebra was obtained in flexion and extension. The amount of sagittal translation was established as the displacement difference in millimeters. The angulation of the segment was also measured as the difference in degrees between the angles in flexion and extension. Movement was classified into three groups: without movement, with movement (≤ 3 mm and ≤ 10º), and with excessive movement (> 3 mm and > 10º). (Figure 1)

Facet effusion was studied in axial T2-weighted cuts in the lumbar and sacral MRI to analyze its presence and quantity. According to Chaput et al., facet effusion is defined as a curvilinear, measurable, hyperintense signal in the facet joint that resembles cerebrospinal fluid in the axial cut in T2. The thickness of the facet effusion was assessed by taking into account the perpendicular measurement between the medial and lateral borders of the facet joint that appears to have the greatest amount of liquid. Facet effusion was classified into three groups: without effusion, with effusion (≤ 1.5 mm), and with excessive effusion (> 1.5 mm). (Figure 2)

The patients were also evaluated for the presence of spondylolisthesis in the lateral X-ray of the lumbosacral spine in the standing position. The objective of the analysis was to choose between decompression and decompression and arthrodesis for surgical treatment.

All the measurements from radiographic and magnetic resonance studies were taken by an independent examiner, not involved in patient care. We tested the null hypothesis of independence between movement and effusion versus the alternative hypothesis of dependence. The results were described as frequencies and percentages. To evaluate the association between the two categorical variables, we used Fisher’s exact test or the Chi-square test. P-values less than 0.05 indicated statistical significance. The data were analyzed with the IBM SPSS Statistics v.20.0 computational program (IBM Corp., Armonk, NY).
RESULTS

Two hundred and forty-four patients met the criteria and were evaluated between 2014 and 2016. Most of these individuals were 70 years of age or younger, with 109 patients in the ≤ 50 years of age group, 105 patients in the 51-70 years of age group, and 30 patients > 70 years of age. Among the 111 male patients, 33.3% had listhesis. Of these, this percentage was 51.1%. (Table 1)

According to the dynamic X-rays, 166 patients presented no movement, 47 presented movement (≤3 mm), and 31 presented excessive movement (>3 mm). In the MRI evaluation, 83 did not present facet effusion, 115 presented effusion (≤1.5 mm) and 46 presented excessive effusion (>1.5 mm). In the population studied, the incidence of facet effusion was 47.1%, while that of excessive effusion was 18.9%. In turn, the incidence of effusion in the patients with movement was 53.2% and excessive effusion in patients with movement was 29%. One hundred and sixty-five patients (67.6%) underwent arthrodesis.

Statistical analysis results indicated no significant association between segmental movement and the presence of effusion. (Table 2) It was also not possible to determine any significant association between facet effusion and an indication of arthrodesis. (Table 3) Confounding factors to lumbar spine instability as of pseudo-gout.

Table 4. Association between sex and spondylolisthesis.

| Spondylolisthesis | Male | Female |
|-------------------|------|--------|
| No                | 74   | 65     |
| Yes               | 37   | 68     |
| Total             | 111  | 133    |

DISCUSSION

Low back pain is a common complaint, affecting approximately 84% of the population at some point in their lives. In spite of the technological advances in diagnostic methods, the identification of the specific cause of low back pain can be costly. It is believed that facet degeneration can be performed in the dynamic X-ray. (flexion and maximum extension). The amount of translation and rotation in the sagittal plane is calculated and compared with normality variations. White and Panjabi defined radiographic instability as translation in the sagittal plane greater than 4.5 mm or greater than 15% of the vertebral body as well as rotation in the sagittal plane greater than 15° in segments L1-L2, L2-L3, and L3-L4 greater than 20° in segment L4-L5, and greater than 25° in segment L5-S1. Other authors established 4 mm of translation or 10° of angulation as reference values. In their evaluation of translation in dynamic X-rays of asymptomatic patients, Boden et al. defined a value of 3 mm as the standard. Many studies have described the association of facet profit and lumbar segmental instability. Ben-Galim and Reitman discussed the "distended facet sign", which they believed to be indicative of position-dependent canal stenosis and degenerative spondylolisthesis. Kim and Wang treated the facet effusion sign as an intermediate phase in the progression of degeneration. Other studies also have pointed to an association between facet joint degeneration and disc degeneration, which are important contributing factors to lumbar spine instability. These and other studies on the topic used the two-dimensional plane as a reference. Although we also used the two-dimensional plane and a low instability threshold (> 3 mm and > 10°) for our standard, it was not possible to confirm an association between facet effusion and radiographic instability in the sagittal plane in our study. It is possible that there are situations in which facet effusion is associated with a condition of three-dimensional instability not detected with the dynamic radiographic. Interaction between facet effusion and the presence of listhesis. (Table 4) Confirming association between facet effusion and an indication of arthrodesis. (Table 3)
of facet effusion does not influence a therapeutic decision between decompression and decompression and arthrodesis.

Several limitations of our study should be considered. The patients were evaluated retrospectively, which may have introduced an analysis bias. Despite the large number of patients evaluated (244 patients), the samples with excessive movement and excessive effusion were small, a 32 and 46 patients, respectively.

CONCLUSION

The incidence of facet effusion in patients submitted to lumbar spine surgery was 47.1%, while the incidence of excessive liquid was 18.8%. The incidence of movement was 19.3% and of excessive movement was 12.7%. There was no association between facet effusion in the magnetic resonance and excessive movement in the dynamic radiograph. The presence of effusion did not influence the choice of treatment between decompression or decompression and arthrodesis. Therefore, MRI does not replace X-ray in flexion and extension in the evaluation of lumbar instability.

All authors declare no potential conflict of interest related to this article.

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REFERENCES

1. Fritz JM, Piva SR, Childs JD. Accuracy of the clinical examination to predict radiographic instability of the lumbar spine. Eur Spine J. 2005;14(8):743-50.
2. Hasegawa K, Kihara H, Shimoda H, Ishi K, Oto M, Homma T, et al. Lumbar degenerative spondylolisthesis is not always unstable: clinicobiomechanical evidence. Spine (Phila Pa 1976). 2014;39(26):2127-35.
3. Iguchi T, Kanemura A, Kashiwara K, Kurhara A, Doita M, Yoshiha S. Age distribution of three radiologic factors for lumbar instability: probable aging process of the instability with disc degeneration. Spine (Phila Pa 1976). 2003;28(23):2629-33.
4. Tamai K, Kato M, Konishi S, Matsumura A, Hayashi K, Nakamura H. Facet Effusion without Radiographic Instability Has No Effect on the Outcome of Minimally Invasive Decompression Surgery. Global Spine J. 2017;7(1):21-7.
5. Schrinner KA, Katz LD, Grauer JN. MR findings of exaggerated fluid in facet joints predicts instability. Clin Spine Surg. 2008;21(7):468-72.
6. Simmonds AM, Rampersaud YR, Dvorak MF, Dea N, Melnyk AD, Fisher CG. Defining the inherent stability of degenerative spondylolisthesis: a systematic review. J Neurourosurg Spine. 2015;23(2):178-99.
7. Hasegawa K, Kihara H, Shimoda H, Hara T. Facet joint opening in lumbar degenerative diseases indicating segmental instability. J Neurourosurg Spine. 2010;12(6):687-93.
8. Peper CC, Grotz SF, Nadal J, Schild HH, Niggemann PD. Radiographic evaluation of vertebral instability in lumbar spondylolisthesis: do we need extension radiographs in routine exams? Eur Spine J. 2014;23(2):961-9.
9. Caterini R, Mancini F, Bisciazzo S, Maglione P, Farsetti P. The correlation between exaggerated fluid in lumbar facet joints and degenerative spondylolisthesis: prospective study of 52 patients. J Orthop Traumatol. 2011;12(2):87-91.
10. Chaput C, Padon D, Rush J, Lenihan E, Rahm M. The significance of increased fluid signal on magnetic resonance imaging in lumbar facets in relationship to degenerative spondylolithesis. Spine (Phila Pa 1976). 2010;35(10):E409-12.
11. Chen H, Lee CC, Chang YH, Liang CC. Magnetic resonance imaging of the lumbar facet joint: a case report. Spine (Phila Pa 1976). 2002;27(17):E396-8.
12. de Jongh R, Mancini F, Bisicchia S, Maglione P, Farsetti P. The correlation between exaggerated fluid in facet joints predicts instability. Acta Radiologica. 1944;25(5-6):593-609.
13. Hasegawa K, Kitahara K, Shimoda H, Ishii K, Doita M, Yoshiha S. Age distribution of three radiologic factors for lumbar instability: probable aging process of the instability with disc degeneration. Spine (Phila Pa 1976). 2003;28(23):2629-33.
14. Tamai K, Kato M, Konishi S, Matsumura A, Hayashi K, Nakamura H. Facet Effusion without Radiographic Instability Has No Effect on the Outcome of Minimally Invasive Decompression Surgery. Global Spine J. 2017;7(1):21-7.
15. Schrinner KA, Katz LD, Grauer JN. MR findings of exaggerated fluid in facet joints predicts instability. Clin Spine Surg. 2008;21(7):468-72.
16. Simmonds AM, Rampersaud YR, Dvorak MF, Dea N, Melnyk AD, Fisher CG. Defining the inherent stability of degenerative spondylolisthesis: a systematic review. J Neurourosurg Spine. 2015;23(2):178-99.
17. Hasegawa K, Kihara H, Shimoda H, Hara T. Facet joint opening in lumbar degenerative diseases indicating segmental instability. J Neurourosurg Spine. 2010;12(6):687-93.
18. Peper CC, Grotz SF, Nadal J, Schild HH, Niggemann PD. Radiographic evaluation of vertebral instability in lumbar spondylolisthesis: do we need extension radiographs in routine exams? Eur Spine J. 2014;23(2):961-9.
19. Caterini R, Mancini F, Bisciazzo S, Maglione P, Farsetti P. The correlation between exaggerated fluid in lumbar facet joints and degenerative spondylolisthesis: prospective study of 52 patients. J Orthop Traumatol. 2011;12(2):87-91.
20. Chaput C, Padon D, Rush J, Lenihan E, Rahm M. The significance of increased fluid signal on magnetic resonance imaging in lumbar facets in relationship to degenerative spondylolithesis. Spine (Phila Pa 1976). 2010;35(10):E409-12.
21. Chen H, Lee CC, Chang YH, Liang CC. Magnetic resonance imaging of the lumbar facet joint: a case report. Spine (Phila Pa 1976). 2002;27(17):E396-8.
22. de Jongh R, Mancini F, Bisicchia S, Maglione P, Farsetti P. The correlation between exaggerated fluid in facet joints predicts instability. Acta Radiologica. 1944;25(5-6):593-609.
23. Hasegawa K, Kihara H, Shimoda H, Ishii K, Doita M, Yoshiha S. Age distribution of three radiologic factors for lumbar instability: probable aging process of the instability with disc degeneration. Spine (Phila Pa 1976). 2003;28(23):2629-33.
24. Tamai K, Kato M, Konishi S, Matsumura A, Hayashi K, Nakamura H. Facet Effusion without Radiographic Instability Has No Effect on the Outcome of Minimally Invasive Decompression Surgery. Global Spine J. 2017;7(1):21-7.
25. Schrinner KA, Katz LD, Grauer JN. MR findings of exaggerated fluid in facet joints predicts instability. Clin Spine Surg. 2008;21(7):468-72.