

Radiographic segmental instability in patients with symptomatic structural lumbar spine pathologies. Is this an important finding?

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ABSTRACT

Background: Radiographic instability has been frequently described as an important component in clinical evaluation of patients with lumbar spine pathologies, there is a controversy about its real utility and clinical implications in lumbar pathology, because it has been described as high frequent also in asymptomatic patients and not correlated with clinical symptoms. The aim of the study was to describe the frequency of radiographic instability in a sample of patients with symptomatic structural pathologies of the lumbar spine. **Material and methods:** It was conducted a descriptive, observational, cross-sectional study. There were included patients with lumbar spine structural pathologies and measured dynamic lumbar radiographs. The radiographs were evaluated for instability using the Dupuis technique. Descriptive statistics and bivariate analysis were calculated. **Results:** Sixty patients were included, of which 76% presented some grade of instability, 60% of this instability was angular (60% in the affected segment and 40% in the adjacent) and 16% translational (55% affected segment and 45% adjacent). **Conclusions:** Segmental instability is highly prevalent in both, but more in angular than translational planes, although it has been described in the same proportion in healthy asymptomatic individuals; neither type or intensity of symptoms were correlated with angular or translational instability.

Key words: Lumbar spine, joint instability, low back pain, radiography.

RESUMEN

Antecedentes: La inestabilidad radiográfica se describe frecuentemente como un componente importante en la evaluación clínica de la columna, existe controversia sobre su utilidad real y las implicaciones clínicas en la patología lumbar, debido a que su presencia se ha descrito como altamente frecuente en sujetos asintomáticos y no necesariamente se correlaciona con los síntomas. El objetivo del estudio es describir la frecuencia de inestabilidad segmentaria en una muestra de pacientes con patologías estructurales sintomáticas de la columna lumbar. **Material y métodos:** Se realizó un estudio descriptivo, transversal, observacional. Se incluyeron pacientes con patologías estructurales lumbares y se midieron sus radiografías dinámicas utilizando la técnica de Dupuis. **Resultados:** Se incluyeron 60 pacientes, el 76% presentó algún grado de inestabilidad, 60% fue angular (60% en el segmento afectado y 40% en el adyacente) y 16% traslacional (55% en el nivel afectado y 45% en el adyacente). **Conclusiones:** La inestabilidad es altamente prevalente en los planos traslacional y angular, aunque se ha descrito en la misma proporción que en individuos sanos, ni los tipos o intensidad de los síntomas se correlacionaron con la presencia de inestabilidad.

Palabras clave: Columna lumbar, inestabilidad articular, dolor de espalda baja, radiografía.

INTRODUCTION

Segmental instability, measured in dynamic radiological studies, is defined as the anterior or posterior translational displacement of a vertebral body against another, and/or an angular variation in the inter-somatic space¹. This can be theoretically explained by alterations in the passive stability system, which is affected in the first stages of the spine degeneration process².

One of the most available resources for the evaluation of instability is a dynamic radiographic study: it does not only provide a vision of bone condition, but also an indirect form

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of evaluating the soft tissue surrounding the vertebral spine.

Dynamic techniques exist to measure segmental instability through the evaluation of translational and angular displacement. They are based on the measurement of lateral and dynamic radiographs in flexion-extension³.

These radiographic techniques are simple for the evaluation of instability, and its determination could have diagnostic and therapeutic implications.

The objective of the present study was to evaluate a sample of patients with structural lumbar spine pathologies seeking for instability measured radiographically.

MATERIAL AND METHODS

This was a descriptive, observational and cross-sectional study to evaluate segmental radiographic instability.

Participants were a consecutive non randomized sample of patients with lumbar spine pathology, above 18 years of age, being seen for the first time in the outpatient clinic of the National Institute of Rehabilitation of Mexico. All patients included had a structural pathology confirmed by para-clinic studies (X-ray, tomography or magnetic resonance), and had symptoms related to the lumbar pathology.

The study was registered in the Institutional Investigation Committee (Review Board) with the number 38-11.

Patients were contacted and asked to perform lateral and dynamic lumbar radiographs. Measurements were

performed by three independent blinded observers who had been previously trained in the measurement technique. The technique for taking the X-rays consisted in placing the patient in bipedalism in a lateral profile, and asking them to do the maximum flexion and extension, respecting the width of the imaging plate chassis.

Once images were obtained, they were evaluated using the Dupuis method, which measures translational displacement through a percentage (D%) obtained with the formula: $D\% = (Dp/Dv) \times 100$, where Dp is the distance between the parallels at an inter-somatic space level, and Dv is the distance between the anterior and posterior plane of the vertebral body. Angular displacement is obtained by tracing a line on the inferior and superior platform of the vertebral bodies to the spinous process. If these intersect, the angle is measured in all three projections⁴, as shown in *figure 1*.

Segmental instability was considered to be translational displacement greater than 4mm or angular variation of $\geq 10^\circ$ in L1-L4, or of $\geq 2^\circ$ in L5-S1⁵.

Descriptive statistics was carrying out to summarize data, using mean and standard deviation as central tendency and dispersion measures. Intra-class correlation coefficients were calculated to asses' validity of radiographic measurements. For bivariate analysis it was used χ^2 and Mann-Whitney U tests. The alpha value took was < 0.005 . It was used the IBM SPSS statistics version 22.0 Armonk, NY: IBM Corp.

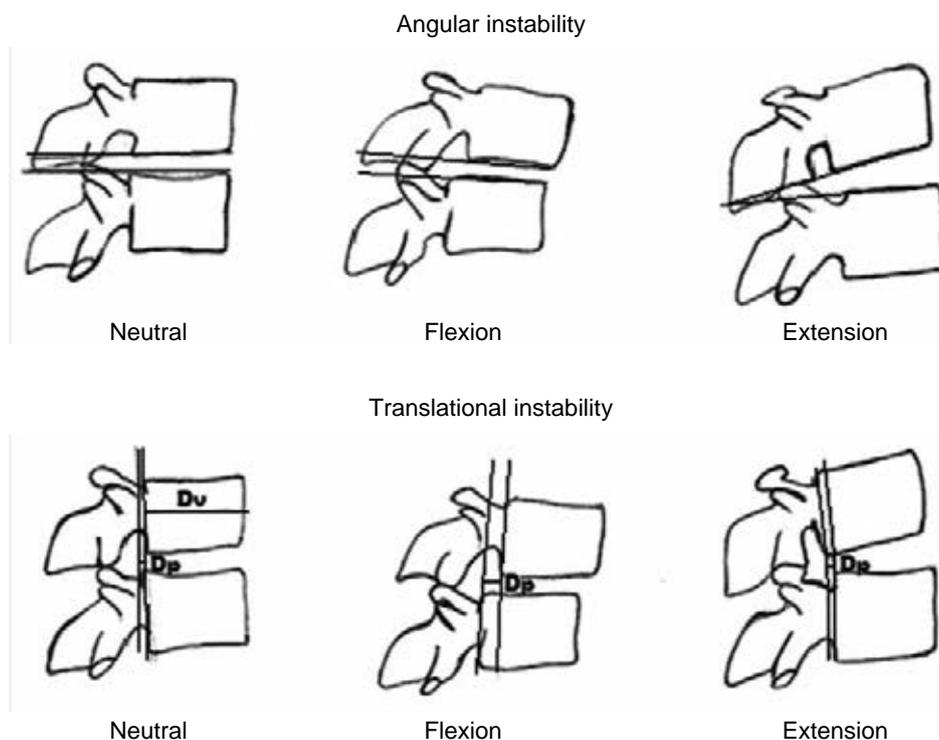


Figure 1.

Translational and angular measurement for lumbar segmental instability according to the Dupuis method.

RESULTS

Sixty patients were included: the mean age was 56 ± 13 years, 53% were women.

Sixteen patients (26%) had an occupation considered as risk for low back pain (farm workers, construction workers). Symptoms and diagnosis are presented in *table 1*.

The intraclass correlation coefficient for the Dupuis technique among observers is shown in *table 2*.

Of the entire sample, 46 (76%) presented instability, 36 (60%) of those were angular and 10 (16%) were translational. The angular instability frequency by segment is shown in *table 3*. Of all the cases with translational instability, 6 (60%) presented instability in the affected segment and 4 (40%) in the adjacent segments.

Angular and translational displacement was not significantly associated with education level, sex, diagnosis, time of evolution, nor type of symptomatology ($p > 0.05$).

DISCUSSION

Our findings show a high prevalence of segmental instability 46 (76%), with angular instability dominating 32 (60%).

Table 1. Frequency and percentages for symptomatology and diagnosis.

	Frequency	Percentage
Symptomatology		
Lumbo-sciatic pain	30	50.0
Neurogenic claudication	20	33.3
Lumbar pain	10	16.7
Total	60	100.0
Structural diagnosis		
Disk disease	14	24.3
Degenerative scoliosis	2	3.3
Lumbar spinal stenosis	10	16.7
Spondylolisthesis	32	53.3
Spondyloarthritis	2	3.3
Total	60	100.0

Despite this, no correlation was found between the degree of instability and symptomatology. Radiographic differences between normal movement and symptomatic instability are difficult to distinguish, as reference ranges for the movement of spinal segments are variable⁶. Reyes-Sánchez et al. reported translational displacement of up to 3mm in all lumbar segments in 74% of asymptomatic subjects between 18 and 30 years of age, which is similar than our study. Hayes et al. report findings of up to 4 mm of displacement in L4-L5 and of 3 mm in L5-S1, also in asymptomatic individuals^{7,8}. Although this, angular displacement was the more prevalent but it is not clear the relationship between this type of instability and the presence of symptoms.

The Macnab and Kasuhiro theory, explicate instability as part of a degenerative process. These authors propose that osteoarthritis in joint facets could induce sUBLuxation in these joints, which has repercussions in angular stability, and posteriorly in translational sliding^{9,10}, but this high proportion of instability was also found in other studies in healthy individuals. Kirkaldy-Willis et al. propose the concept of a «degenerative cascade» in the spinal vertebra. They suggest that segmental instability management must be based on the severity of the instability, and describe three stages. In the first stage a dysfunction without instability is present, the second stage is characterized by instability given by an increase in segmental movement in a pathological manner;

Table 3. Frequency of angular segmental instability by lumbar level.

Level	Frequency	Percentage
L1-L2	6	10.0
L2-L3	4	6.7
L3-L4	12	20.0
L4-L5	12	20.0
L5-S1	32	53.3

Table 2. Intraclass correlation coefficient for angular and translational instability.

Segment	Angular instability					p
	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1	
Coefficient	0.88	0.818	0.79	0.87	0.91	< 0.001
Segment	Translational instability					p
	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1	
Flexion	0.71	0.88	0.94	0.87	0.88	< 0.001
Extension	0.91	0.92	0.83	0.93	0.88	< 0.001

the third stage is a process of re-stabilization associated or not with instability of the adjacent segment¹¹. According to this, our study suggests that patients are at a stage of instability in which the inter-segmental angle is most often affected in any lumbar spine pathologies, but again, this is a finding described also in asymptomatic individuals. So the relationship among the functional concepts of dysfunction, instability, and stabilization is not clear.

Panjabi proposes a concept regarding the stabilization system of the vertebral spine. He describes a neutral zone as a space of physiological displacement between functional units of the spine, where minimal tension exists on passive structures and with an optimal participation of the active subsystem and neural control. A dysfunction in any of these subsystems must be compensated by the others. This means that a patient presents signs of instability as measured by radiography, the deficit could be compensated under therapeutic treatment¹²; but, as it has been said, it is difficult to distinguish the pathologic implications of this finding.

Even though other radiographic techniques have been described to measure instability, their reliability and concordance have not been reported^{5,13}. Our findings show that the Dupuis method is a simple measurement and reliable between observers.

With the present study we found that segmental instability, as measured by radiography, in symptomatic patients with lumbar spine pathology has the same high frequency in symptomatic individuals with structural spine pathologies than in healthy young population described in other studies.

Although we recognize the limitations that the small sample size imposes and the wide variability of structural diagnoses, this study calls attention to perform a study with a healthy control group paired by age and gender, in order to confirm the findings.

CONCLUSIONS

Diagnosing this instability could not have decisive implications in the therapeutic integration of patients with lumbar spine pathology. And this could call the attention in regarding of recommending or not routine evaluation of instability in patients with structural spine pathologies, our findings suggest a careful evaluation of each case before considering radiographic dynamic assessment.

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