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CORRELATION BETWEEN THE MODIC I SIGN AND IMAGES OF VERTEBRAL INSTABILITY

CORRELAÇÃO ENTRE SINAL MODIC I E IMAGEM DE INSTABILIDADE VERTEBRAL

CORRELACIÓN ENTRE SIGNO DE MODIC I E IMAGEN DE INESTABILIDAD VERTEBRAL

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ABSTRACT

The lumbar region is highly affected by degenerative diseases and can be symptomatic as a result of inflammatory processes of the disc or segmental vertebral instability (SVI), according to concepts by White and Panjabi. Magnetic resonance imaging (MRI) and dynamic radiographs can be used to evaluate it. Objective: To determine whether images of Modic type I lesions are compatible with radiological vertebral instability. Methods: The MRIs and dynamic radiographs of 100 patients with a mean age of 46.94 years, 65 of whom were women and 35 of whom were men, were studied to evaluate the reaction of endplates according to Modic and SVI at levels L2-L3, L3-L4, L4-L5 and L5-S1. They were divided into 3 groups: A- Modic I and SVI; B- Modic I without SVI; and C- Without Modic I and SVI. Sex, age and type of disc were evaluated. Result: 46 Modic I lesions and 24 cases of SVI were recognized. There were 5 patients in Group A (OR 0.23, p=0.006), 38 in Group B; and 19 in Group C. No direct relationship between age and Modic I and/or SVI was observed. Pfirrmann grade 5 discs are 4.6 times more likely to present a Modic I signal. The most affected disc was L3-L4 for the Modic signal and L4-L5 with respect to the SVI, translational instability being more frequent. Conclusions: Modic type changes, identified by magnetic resonance, are clinically relevant in relation to low back pain, but their presence does not confirm either translational or angular instability. ***Level of evidence III; Cross-sectional cohort.***

Keywords: Intervertebral Disc Degeneration; Low Back Pain; Pain.

RESUMO

A região lombar é altamente afetada por doenças degenerativas e pode ser sintomática em decorrência de processos inflamatórios do disco ou de instabilidade vertebral segmentar (IVS), de acordo com os conceitos de White e Panjabi. A ressonância magnética (RM) e as radiografias dinâmicas podem ser usadas para sua avaliação. Objetivo: Determinar se as lesões do tipo Modic I são imagens compatíveis com instabilidade vertebral radiológica. Métodos: Imagens de RM e radiografias dinâmicas de 100 pacientes (65 mulheres e 35 homens) com média de idade de 46,94 anos para avaliar a reação dos platôs de acordo com Modic e IVS nos níveis L2-L3, L3-L4, L4-L5 e L5-S1. Os pacientes foram divididos em três grupos: A - Modic I e IVS; B - Modic I sem IVS e C - Sem Modic e IVS e foram avaliados quanto a sexo, idade e tipo de disco. Resultados: Foram reconhecidas 46 lesões Modic I e 24 IVS. O Grupo A tinha 5 pacientes (OR 0,23 p.0,006), o Grupo B, 38 e o Grupo C, 19. Não se constatou relação direta entre a idades com Modic e/ou IVS. Os discos tipo 5 de Pfirrmann têm 4,6 vezes mais chances de apresentar sinal Modic I. Os discos mais afetados foram L3-L4 no sinal Modic e L4-L5 com relação ao IVS, sendo o translacional mais frequente. Conclusões: As mudanças do tipo Modic como dados de ressonância são clinicamente relevantes com relação à lombalgia, mas sua presença não confirma instabilidade translacional ou angular. ***Nível de evidência III; Coorte transversal.***

Descritores: *Degeneração do Disco Interverbral; Dor Lombar; Dor.*

RESUMEN

La región lumbar es muy afectada por la enfermedades degenerativas y puede ser sintomática debido a procesos inflamatorios del disco o inestabilidad vertebral segmentaria (IVS), según los conceptos de White y Panjabi. La resonancia magnética (RM) y las radiografías dinámicas se pueden utilizar para su evaluación. Objetivo: Determinar si las lesiones tipo Modic I son imágenes compatibles con inestabilidad vertebral radiológica. Métodos: Imágenes de RM y de radiografías dinámicas de 100 pacientes (65 mujeres y 35 hombres) con promedio de edad de 46,94 años para evaluar la reacción de las mesetas según Modic e IVS en los niveles L2-L3, L3-L4, L4-L5 y L5-S1. Los pacientes se dividieron en tres grupos: A - Modic I e IVS; B - Modic I sin IVS y C - Sin Modic e IVS y fueron evaluados por sexo, edad y tipo de disco. Resultados: Se reconocieron 46 lesiones Modic I y 24 IVS. El Grupo A tenía 5 pacientes (OR 0,23 p.0,006), en Grupo B 38 y el Grupo C 19. No hubo relación directa entre la edad con Modic y/o IVS. Los discos tipo 5 de Pfirrmann tienen4,6 veces más probabilidad de presentar una señal Modic I. Los discos más afectados fueron L3-L4 en la señal de Modic y L4-L5 con respecto a la IVS, siendo el traslacional el más frecuente. Conclusiones: Los cambios de tipo Modic como datos de la resonancia, son clínicamente relevantes con relación al dolor lumbar pero su presencia no confirma la inestabilidad traslacional o angular. ***Nivel evidencia III; Cohorte transversal.***

Descriptores: *Degeneración del Disco Intervertebral; Lumbalgia; Dolor.*

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INTRODUCTION

The lumbar region of the spine is one of the areas most frequently affected by degenerative pathology and it is often associated with pain.[1,2]

Modic type I lesions are more often associated with lumbar pain than the other types and correspond to a state of hypervascular inflammation, which may involve some degree of microinstability.[3-6]

Lumbar spine instability is associated with lumbar pain and is strongly related to degenerative changes of the discs and joints and to the presence of morphological and structural changes of the yellow ligament;[1,2] and it is difficult to diagnose.[7]

Evaluation using neutral lateral and anteroposterior radiographs is recommended in all patients with lumbar symptoms that persist for more than 4 to 6 weeks.[2,8]

Lateral radiographs of flexion and extension are performed to assess dynamic vertebral instability[8] and have been interpreted by White and Panjabi,[9] in which translation or hypermobility during flexion-extension can be signs of segmental instability.[1,10]

However, MRI continues to be the most sensitive and specific method for evaluating intervertebral disc pathology, and even more so if a dynamic resonator is available.[1,5,11]

Our objective was to determine whether images of Modic type I lesions are compatible with radiological vertebral instability.

METHODS

An observational, analytical, cohort-type evaluation of patients with mechanical low back pain was performed using both magnetic resonance images (MRI) of the lumbosacral spine and lateral radiographs of the same segment in maximum flexion (LMF) and maximum extension (LME). A cohort study of 100 patients, 65 of them women and 35 men, ranging in age from 16 to 84 years of age (mean of 46.94) was conducted.

The intervertebral discs and endplates of L2-L3, L3-L4, L4-L5 and L5-S1 were evaluated.

The following parameters were used as inclusion criteria: mechanical low back pain, the presence of a Modic type I (inflammatory) magnetic resonance image, and segmental vertebral instability values in dynamic radiographs (difference in displacement >3 mm and/or in angulation >12°).

Patients with fractures, tumors, infections and prior surgeries were excluded.

The patients were divided into three groups: Group A: Modic I patients with instability parameters; Group B: Modic I patients without instability parameters; and Group C: Patients without Modic I with instability parameters. Patient age, sex, and disc type according to the Pfirrmann scale (Table 1) were recorded for each group.

The data were loaded into an Access database and analyzed using Epi Info 3.3.2 and evaluated using chi-squared, the odds ratio, and the student's t-test.

Table 1. Lumbar disc degeneration evaluation system (Pfirrmann).

Grade	Intensity of the signal of the nucleus	Structure of the nucleus	Differentiation between the nucleus and the annulus fibrosus	Disc height
I	Hyperintense	Homogeneous, white	Clear	Normal
II	Hyperintense Isointense	Heterogeneous, with a horizontal white band	Clear	Normal
III	Intermediate	Heterogeneous, gray	Not clear	Normal or slight loss
IV	Intermediate to hypointense	Heterogeneous, gray to black	Lost	Normal or moderate loss
V	Hypointense	Heterogeneous, black	Lost	Collapsed

RESULTS

All the L2-L3, L3-L4, and L4-L5 levels and 99 of the L5-S1 levels were evaluated, because one L5-S1 level was completely sacralized.

Forty-six Modic I lesions and 24 radiological instabilities were identified.

Only 5 patients presented Modic I associated with instability (Group A). Of these, 4 were in the 40-60 years of age group and one was in the 20-40 years of age group. The L3-L4 disc was affected in one case and the L4-L5 level in the other four. The L3-L4 disc was a Pfirrmann classification grade 3. Of the four L4-L5 discs, three were Pfirrmann classification grade 5 and one was grade 4. Four in this group presented instability from translation and one from angular instability. (Table 2)

In Group B, 38 levels presented Modic I lesions without instability. There were three Modic lesions at level L2-L3, with one disc each of grades 1, 4, and 5. At the L3-L4 level, there were a total of five Modic lesions, two grade 3, one grade 4, and two grade 5. At level L4-L5 there were sixteen Modic lesions, with two grade 3, five grade 4, and six grade 5. At the L5-S1 level, there were 17 Modic lesions, one with disc grade 1, two grade 3, four grade 4, and ten grade 5. (Table 3)

There were 19 patients in Group C, the instability without Modic group. Eighteen of them had transitional instability and one had angular instability. There were 16 instabilities at level L4-L5, 10 of which were classified as Pfirrmann grade 3, three as grade 4 and two as grade 5. At level L3-L4 there were three instabilities, with two grade 3 discs and one grade 4 disc. There was only one unstable L5-S1 with a grade 5 disc. (Table 4)

The statistical analysis performed showed that there is a 4.6 times greater chance of having an inflammatory Modic signal (Modic I) in the presence of a Pfirrmann grade 5 disc (odds ratio of 4.670 with $p=0.0001$).

The possibility of presenting a Modic lesion and SVI at the same level is very low (odds ratio of 0.26 with $p=0.006$).

We did not observe any direct relationship between age and the Modic lesion and/or the SVI.

DISCUSSION

Only 5 patients had Modic I associated with instability (Group A). This result observed in the study was not adequately discussed. In the discussion, the authors stated that the Modic type I lesion is more often associated with lumbar pain than the other types and corresponds to a hypervascular inflammatory state in which some degree of microinstability may exist.[4]

Degenerative disc disease is a common problem that often increases with age.[1,2,11,12]

Pfirrmann suggests correlations between degenerative lesions and structural changes in the intervertebral endplates in cases of association between both pathologies, and proposed a classification of disc degeneration based on 5 grades.[13]

Modic[3] formulated a simple and easy method for interpreting degenerative disc disease linked to changes in the bone marrow signal into three distinct types. These vertebral endplate lesions were described in 1988 and are estimated to have a prevalence of between 22% and 50% in patients with degenerative intervertebral disc disease.[3,4,14-16]

Modic type I lesions are more often associated with low back pain than the other types and correspond to a hypervascular inflammatory state in which some degree of microinstability may exist.[4-6] This state of supposed instability may be a sign of active

Table 2. List and characteristics of the Group A patients (Modic I and SVI).

No.	Sex	Age	Modic	SVI	Pfirrmann	Level
4	F	49	1	Yes	3	L4-L5
8	M	34	1	Yes	5	L4-L5
15	F	46	1	Yes	3	L3-L4
24	M	53	1	Yes	5	L4-L5
57	F	55	1	Yes	5	L4-L5

Table 3. List and characteristics of the Group B patients (Modic I without SVI).

No.	Sex	Age	Modic	SVI	Pfirrmann	Level
1	F	33	1	No	5	L4-L5
3	F	42	1	No	5	L5-S1
6	F	20	1	No	4	L4-L5
11	M	57	1	No	4	L4-L5
12	F	66	1	No	5	L5-S1
13	M	50	1	No	5	L2-L3
14	F	53	1	No	4	L5-S1
16	F	49	1	No	4	L5-S1
18	M	36	1	No	5	L5-S1
21	F	55	1	No	5	L5-S1
23	F	54	1	No	4	L4-L5
29	F	37	1	No	1	L2-L3
30	M	36	1	No	5	L4-L5
31	M	51	1	No	3	L3-L4
33	M	49	1	No	5	L3-L4
34	M	59	1	No	5	L5-S1
37	M	40	1	No	3	L4-L5
47	F	46	1	No	5	L5-S1
51	F	39	1	No	5	L5-S1
53	F	45	1	No	4	L2-L3
55	F	70	1	No	4	L5-S1
62	F	45	1	No	5	L5-S1
66	F	50	1	No	4	L4-L5
67	F	40	1	No	5	L4-L5
68	F	84	1	No	5	L5-S1
71	F	75	1	No	3	L4-L5
73	F	59	1	No	5	L5-S1
77	F	52	1	No	4	L3-L4
81	F	54	1	No	5	L4-L5
83	F	56	1	No	5	L4-L5
84	M	45	1	No	3	L3-L4
85	F	75	1	No	5	L4-L5
86	F	42	1	No	4	L4-L5
87	F	58	1	No	3	L5-S1
91	F	50	1	No	4	L5-S1
94	M	39	1	No	1	L5-S1
96	M	50	1	No	3	L5-S1
97	F	54	1	No	5	L3-L4

degeneration.[6] Type I lesions commonly progress to type II, but they also may go into remission.[5,16] However, the morphological differences do not always correlate with the symptoms.[15]

Modic II is defined as a more stable state in which fat replacement is a continuation of the degenerative process.[6] Braithwaite et al. report that the different Modic changes are the consequence of different states of the same pathology.[16, 17]

Several authors[4-6,8] indicate that the inflammatory lesions (I) are associated with SVI in 40% of cases and the degenerative lesions (II) in 20%. In our study we only analyzed the patients with Modic I (Groups A and B) and 11.63% of these patients presented SVI, a number less than that reported in the international literature.

Table 4. List and characteristics of the patients in Group C (Without Modic I and with SVI).

No.	Sex	Age	Modic	SVI	Pfirrmann	Level
10	F	43	0	Yes	3	L4-L5
17	F	45	0	Yes	3	L4-L5
20	M	31	0	Yes	4	L4-L5
35	M	49	0	Yes	3	L4-L5
36	F	39	0	Yes	3	L4-L5
42	F	55	0	Yes	5	L5-S1
46	M	44	0	Yes	4	L4-L5
48	F	68	0	Yes	5	L4-L5
49	F	54	0	Yes	3	L4-L5
52	M	62	0	Yes	3	L4-L5
58	F	57	0	Yes	4	L4-L5
63	F	28	0	Yes	3	L3-L4
70	M	64	0	Yes	4	L4-L5
76	F	52	0	Yes	4	L3-L4
79	F	80	0	Yes	3	L4-L5
80	F	54	0	Yes	3	L4-L5
89	F	48	0	Yes	5	L4-L5
92	F	25	0	Yes	3	L3-L4
100	F	64	0	Yes	3	L4-L5

Of the total patient sample analyzed, 38.71% presented the SVI sign and the relationship with Modic I was observed in 26.32% of these.

Malinin and Brown[18] conducted studies in primates and stated that vascular disruption of the endplate and the loss of disc support, as the result of microfractures and bone necrosis, explain the pathogenesis of the lesion.[6,18]

Sandhu et al. could not demonstrate any relationship between discography and these changes in the magnetic resonance imaging.[19]

Segmental vertebral instability has been identified in several publications as responsible for low back pain, with degenerative disc pathology being one of those most responsible for low back pain.[11]

The use of dynamic radiographs remains a controversial method. However, it allows us to determine instabilities that could go unnoticed in static radiographs and magnetic resonance.[8]

With technological advances, such as dynamic magnetic resonance imaging, it would be easier to research these pathologies.[1,11,10]

CONCLUSIONS

Segmental instability, especially translational instability, is often an important factor in determining surgical indications of spinal arthrodesis in patients submitted to decompression surgery.

Modic type changes, identified by magnetic resonance, are clinically relevant in relation to low back pain, but their presence does not confirm either translational or angular instability. Therefore, emphasis must be placed on an analysis of the axial instability of the lumbar spine in order to determine its relationship to this.

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