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Effect of Preoperative Modic Changes on the Outcome of Patients with Lumbar Degenerative Disc Disease Following Posterior Spinal Fusion or Laminectomy

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Abstract

Background: Various MC types have been reported to have an impact on the surgical outcome in LBP patients. Magnetic resonance imaging (MRI) findings of Modic changes (MC) are linked to persistent low back pain (LBP). Different MC types may have an impact on how well individuals with LBP respond to surgery.

Aim of Study: The objective of the study is to assess the impact of preoperative Modic changes (MC) on the prognosis of patients suffering from low back pain (LBP) resulting from degenerative disc disease after posterior spinal fusion (PSF) with laminectomy or laminectomy alone.

Methods: This prospective study was conducted upon 30 patients at Cairo University Hospitals and Beni-Suef university hospital starting in March 2020 to be completed in October 2020. We assessed the outcome at 30 patients with LBP and MC Type I and II who had laminectomy (n=15) or PSF (n=15). MC types were determined using preoperative MRI. The pain intensity was measured using visual analogue scale (VAS) before and three months after surgery.

Results: The study was conducted upon 30 Patients between 30 to 65 years old with a mean 45.5. 17 were males and 13 were females. Low back pain was the most prevalent presenting symptom across all participants, followed by claudication pain in 83.3%. Preoperative to postoperative (VAS) changes were documented in our study. Regarding the type I Modic changes, Pain VAS improved immediately post- operative after both laminectomy only (group A) and laminectomy with PSF (group B) with mean ± SD 3.5 and 2.29 points for group A, B respectively. While Pain VAS 3 months post-operative, patients who underwent management in group B improved more than whose who underwent management in group A with mean ± SD 1.14±0.69 which is statistically significant with *p*-value=0.008. Regarding type II Modic changes, Pain VAS improved immediate post-operative and 3 months post-operative in both groups with no significant difference in values.

Conclusion: Patients with LBP who also have MC benefit greatly from surgical treatment in terms of reduced pain. For patients with MC Type I, PSF appears to be a more effective treatment.

Key Words: *Modic changes – Degenerative disc disease – Low back pain – Outcome – Laminectomy.*

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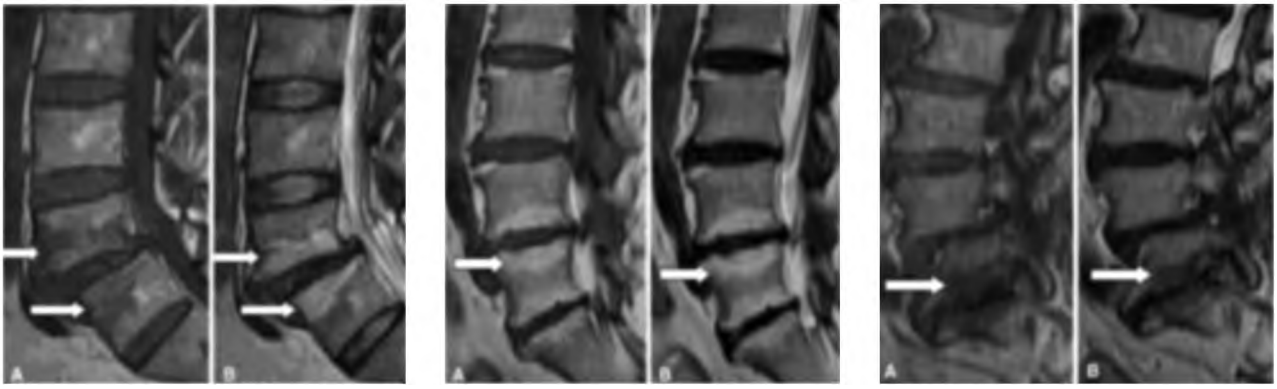
Introduction

MODIC changes (MC) are apparent on magnetic resonance imaging (MRI) as vertebral endplate lesions and changes in bone marrow signal intensity next to a degenerated disc. MCs are classified into three types: Bone marrow edoema (Modic Type I), fat (Modic Type II), and osseous sclerosis (Modic Type III) **[1].**

Numerous studies have revealed a correlation between MCs and chronic low back pain (LBP), with MC Type I having the strongest link. Chronic low back pain is one of the leading causes of disability in adults. LBP is most commonly caused by degenerative disc disease (DDD), which is also associated with MCs, particularly Type I and II **[2].**

The aim of the study is to assess the impact of preoperative Modic changes (MC) Type I and II on the prognosis of patients with low back pain (LBP) resulting from degenerative disc disease after posterior spinal fusion (PSF) with laminectomy or laminectomy alone.



A: Type I : T1 hypo - & T2 hyperintensity.

B: Type II: T1 hyper - & T2 hyperintensity.

C: Type III: T1 hypo - & T2 hypointensity.

Fig. (1): Modic Changes classification.

Patients and Methods

This Prospective comparative study was conducted upon 30 patients with Degenerative Disc Diseases associated with Modic changes. All cases were operated upon in Kasr El-Ainy Hospitals, Cairo University and Beni-Suef University Hospital between March 2020 to October 2020.

Patients are categorized into two treatment groups:

- Group (A): laminectomy and Cauda Equina decompression without posterior spinal fusion (PSF) is performed for patients with neurologic impairments or disc extrusion with spinal root compression causing back pain or radicular pain that is not improving with medication & in those with lateral or central lumbar canal stenosis who do not require the excessive facetectomy without experiencing instability or regional deformity.
- Group (B): Laminectomy and Cauda Equina decompression with PSF.

Exclusion criteria: Patients under the age of 18, had anatomical signs of instability as Spondylolisthesis or fracture pars, had global or regional deformity in spine including scoliosis, kyphosis, had Previous lumbar spine surgery or had a history of trauma to spine.

All patients had thorough history taking with detailed neurological examination with assessment of pain intensity using Visual analogue scale (VAS) with the following grades: No pain was given zero score, mild pain was at score 1-2-3, Moderate pain at score 4-5-6-7, and Severe pain: 8-9-10.

All patients had radiological examination in the form of plain X-rays of the lumbosacral spine with dynamic and oblique views, and MRI of the lumbosacral spine with modic changes appeared in single or multiple levels.

Patients then were assessed for VAS for the back pain in the immediate postoperative period and after 3 months.

To code and enter the data, the statistical program for the social sciences (SPSS) version 26 was utilized (IBM Corp., Armonk, NY, USA). To describe quantitative data, the mean, standard deviation, median, minimum, and maximum values were utilized, while frequency (count) and relative frequency (percent) were employed to summarize categorical data. To compare quantitative variables, the non-parametric Mann-Whitney test was utilized. To compare categorical data, Chi square & Exact tests were used, *p*-values less than 0.05 were considered as statistically significant.

Results

Demographic data:

Out of 30 patients, 17 male patients with a total percentage of 56.7% that was more than female patients who represented 13 from the total number of patients with a total percentage of 43.3%. According to the management plan, most patients who underwent laminectomy only were males with 66.7% in comparison to the PSF group where 53.3% of the patients were females. The age distribution of patients studied was between a minimum of 30 years old and maximum of 65 years old with a mean (±) SD is 45.50 (±) 9.80 and median value of 45.50. Regarding the management plans, the mean age (±) SD of patients who underwent laminectomy was 44.47 (±) 10.23 while the mean age (±) SD of patients who underwent PSF was 46.53 (±) 9.61. (Table 1).

Table (1): The statistical values representing age distribution regarding each management plan.

	Laminectomy only group					PSF group					*p*-value
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Age	44.47	10.23	46.00	30.00	60.00	46.53	9.61	45.00	35.00	65.00	0.775

Clinical manifestations:

Regarding the 30 studied patients, low back pain was the most prevalent presenting complaint across all participants, with different severities (56.7% were severe and 43.3% were moderate), followed by claudication pain in 83.3% of the patients. According to the management plans, patients who underwent laminectomy only all presented with intact motor power, 80% presented with claudication pain and 60% presented with severe low back pain. On the other hand, 86.7% of the patients who underwent PSF had intact motor power and claudication pain preoperatively followed by 53.3% with severe low back pain. (Table 2).

Radiologic data:

Regarding the radiological findings, Modic Changes were predominantly located at level L4-5 (46.67%) followed by L5-S1, L3-4 level (36.67%) and (16.67%) respectively. According to each management plan, most of the patients in group A and group B showed lumbar disc prolapse at the level of L4, L5 with 40% and 46.7% respectively. (Table 3).

Postoperative outcome on VAS:

Regarding the type I Modic changes, Pain VAS improved immediately postoperative after both laminectomy only (group A) and Laminectomy with PSF (Group B). Regarding Pain VAS 3 months post-operative, patients who underwent management in group B improved more than those who underwent management in group A with mean ± SD 1.14±0.69 which is statistically significant with *p*-value=0.008 (Table 4, Fig. 2).

Regarding type II Modic changes, Pain VAS improved immediate postoperative and 3 months post-operative in both groups with no significant difference (Table 5, Fig. 3).

Table (2): Clinical presentation regarding management plans.

		Laminectomy only group		Fixation group		*p*-value
		Count	%	Count	%	
LBP	Mild	0	0.0	0	0.0	0.713
	Moderate	6	40.0	7	46.7	
	Severe	9	60.0	8	53.3	
Claudiction	Yes	12	80.0	13	86.7	1
	No	3	20.0	2	13.3	
Sciatica	Yes	2	13.3	3	20.0	1
	No	13	86.7	12	80.0	
MP pre	Full motor power	15	100.0	13	86.7	0.483
	Has weakness	0	0.0	2	13.3	
Urinary manifestations	Yes	0	0.0	1	6.7	1
	No	15	100.0	14	93.3	

Table (3): Comparison between the management plans regarding the clinical examination and radiological findings.

		Laminectomy only group		Fixation group		*p*-value
		Count	%	Count	%	
MP pre	Full motor power	15	100.0	13	86.7	0.483
	Has weakness	0	0.0	2	13.3	
SLRT	Normal	12	80	13	86.7	0.486
	Affected	3	20	2	13.3	
Imaging	L4-5 canal stenosis	4	26.7	1	6.7	0.396
	L1-5 canal stenosis	0	0.0	1	6.7	
	L3-4-5 canal stenosis	2	13.3	1	6.7	
	L4-5, L5-S1 canal stenosis	0	0.0	2	13.3	
	L3-4, L4-5 DP	0	0.0	1	6.7	
	L5-S1 DP	1	6.7	1	6.7	
	L4-5 DP	6	40	7	46.7	
	L4-5, L5-S1 DP	2	13.3	1	6.4	

Table (4): VAS pre and immediately post-operative and 3 months post-operative in both groups with Type I Modic changes.

Modic changes = Type I	Laminectomy only group					Fixation group					*p*-value
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
VAS pre	7.33	0.82	7.50	6.00	8.00	7.29	0.76	7.00	6.00	8.00	0.945
VAS imd post	3.50	1.05	3.50	2.00	5.00	2.29	0.76	2.00	1.00	3.00	0.051
VAS 3 m post	2.67	0.82	2.50	2.00	4.00	1.14	0.69	1.00	0.00	2.00	0.008

Table (5): VAS pre and immediate post and 3 months post-operative in both groups with Modic changes Type II.

Modic changes = Type I	Laminectomy only group					Fixation group					*p*-value
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
VAS pre	8.22	0.67	8.00	7.00	9.00	7.88	0.64	8.00	7.00	9.00	0.370
VAS imd post	3.56	1.51	3.00	2.00	7.00	3.62	0.92	3.00	3.00	5.00	0.743
VAS 3 m post	2.11	1.17	2.00	0.00	4.00	1.50	0.93	1.50	0.00	3.00	0.277

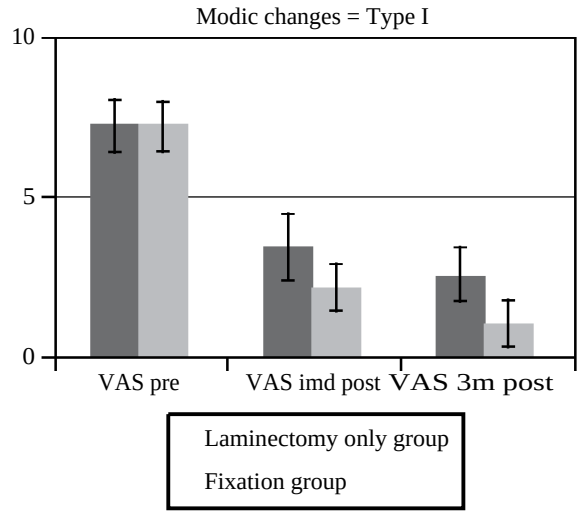


Fig. (2): VAS pre and immediately post-operative and 3 months post-operative in both groups with Type I Modic changes.

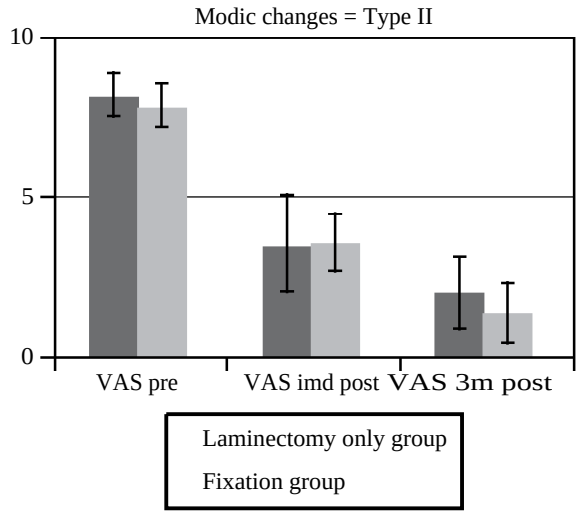


Fig. (3): VAS pre and immediate post and 3 months post-operative in both groups with Modic changes Type II.

Discussion

Sixty to seventy percent of people will experience low back pain (LBP), the most common cause of disability, at some point in their lives **[3].** Moreover, LBP is the most common single diagnosis that drives healthcare and welfare costs; it accounts for 10% of disability pensions and 15% of long-term sick leave; making it the most expensive health facility in the UK **[4].**

Magnetic resonance imaging (MRI)-signal variations in the vertebral endplates are known as modic changes (MCs). They are thought to indicate early inflammation (MC-1) followed by fat degeneration (MC-2) and calcification in the endplate and vertebral body (MC-3) **[5].**

In our study, modic changes were predominantly located at level L4-5 (46.6%) followed by L5-S1, L3-4 level (36.6%) and (16.6%) respectively. Similar to many other studies, **[6,7,8]** which reported the presence of the modic changes at the vertebral interfaces which face the maximal weight bearing forces and in turn, it is understandable why patients with these changes have painful movements during standing and walking. This mandates a comprehensive search for a suitable solution which can help those patients to lead a comfortable lifestyle.

We evaluated the outcomes of PSF and laminectomy in 30 patients with MC I and II in our study and discovered a significant improvement in pain intensity following surgery, documented the preop-

erative & postoperative (VAS) values and followed them up in the postoperative periods. In type I Modic changes, Pain VAS improved immediately postoperative after both laminectomy only (group A) and Laminectomy with PSF (Group B). While Pain VAS 3 months post-operative, patients who underwent management in group B improved better than those who underwent management in group A, the difference between the two groups was statistically significant with *p*-value=0.008.

In patients with type II Modic changes, the difference in pain VAS scores improvement was not statistically significant which may be explained by the relative chronic nature of the MC type II. The dramatic improvement in patients with MC I more than MC II is well documented in the literature **[7,9]**. In fact the early detection and management of the spondylodegenerative changes carries a better chance for early intervention and consequently a better prognosis regarding the patients' quality of life. We believe that the instrumentation of the spine has to be considered significantly in patients with modic changes especially in type 1 which entails stabilization of the relative motion in the vertebral interface which led to the presence of the modic changes primarily and hence reversal of the pathology and in turn the alleviation of the annoying back pain.

The financial burden might be a challenge for instrumentation in the limited resources sittings, yet the proper selection of the patients who need fusion solutions may decrease the influence of this problem. Nevertheless, the relief of the life-rendering pains such as back pain can increase the productivity of the personnels and can push the prosperity forwards for all the community so that every effort should be made to make the fusion options available when needed.

Conclusion:

Modic alterations (changes) are associated with discogenic low back pain and would be indicative of an underlying pathology that should be treated. These patients also have more intense Low back pain than others. without those changes, This could possibly have an impact on the surgical treatment outcome.

In this study, we evaluated the effect of MC Type I and II on patients with back pain due to degenerative disc disease following laminectomy or laminectomy with Posterior Spinal Fusion (PSF).

We observed that surgical treatment in those patients is accompanied with significant improvement in pain. PSF seems to be a better treatment in patients with MC Type I.

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دراسة تأثير وجود تغيرات مودك فى مرضى الانزلاق الغضروفى القطنى على نتائج جراحتى التثبيت الخلفى للفقرات القطنية أو استئصال الصفيحة الخلفية للفقرات القطنية

الخلفية: يعد آلام العمود الفقرى الأكثر شيوعاً بين الآلام المزمنة كما أنها تمثل عبءً من الناحية الأقتصادية والسبب الأول فى التقاعد عن العمل ويعد الإنزلاق الغضروفى من الأسباب الرئيسية فى آلام أسفل الظهر بنسب تتراوح من ٣٠ الى ٤٠٪ بين مرضى آلام العمود الفقرى.

الطريقة: وقد أجريت هذه الدراسة الإستطلاعية العشوائية المقارنة علي مريض يعانون من الام أسفل الظهر الناتجة عن أمراض الغضروف التنكسية القطنية مصحوبة بتغييرات مودك حيث خضع نصف المرضى لاستئصال الصفيحة الفقرية وإزالة الضغط على الجذور العصبية بينما خضع النصف الأخر لما سبق اضافة إلى تثبيت الفقرات بشرائح ومسامير.

النتائج: وقد أظهرت الدراسة مدى كفاءة كلا الإجراءين لتحسين آلام الظهر بعد العملية. وأنه لا فرق بين كلا الإجرائيين بين المرضى الذين يعانون من أمراض الغضروف التنكسية القطنية مصحوبة بتغييرات مودك من النوع الثانى، إلا أن نتائج التحسن كانت أبرز فى المرضى الذين يعانون من أمراض الغضروف التنكسية القطنية مصحوبة بتغييرات مودك من النوع الأول حين تم إجراء استئصال الصفيحة الفقرية وإزالة الضغط على الجذور العصبية مصحوباً بتثبيت الفقرات لهم.