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Original Article

Effect of Preoperative Modic Change in the Outcome of Patients with Low Back Pain Following Posterior Spinal Fusion or Laminectomy

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Abstract

Background: Modic changes (MC), visible on magnetic resonance imaging (MRI) are associated with chronic low back pain (LBP). It is reported that different MC types could affect the surgical outcome in patients with LBP. **Objective:** In this study, we evaluated the effect of MC Type I and II on patients with LBP and degenerative disc disease following posterior spinal fusion (PSF) or laminectomy. **Materials and Methods:** We evaluated the outcome of 162 patients with LBP and MC Type I and II who underwent laminectomy (n = 72) or PSF (n = 90). Preoperative MRI was used to define MC types. Visual analog scale (VAS) was used to evaluate the pain intensity before and 3 months after surgery. **Results:** Patients had MC Type I in 46.3% and Type II in 53.7%. Pain VAS significantly decreased following surgery (7.93 ± 1.27–5.98 ± 1.57, $P < 0.001$). There was no difference between MC Type I and II in pain VAS before (P = 0.51) and after treatment (P = 0.51). Among MC Type I, PSF compared to laminectomy had significantly more improvement in pain VAS (P = 0.01), but the changes in modic Type II were similar between groups (P = 0.89). **Conclusion:** Surgical treatment in patients with LBP with MC accompanies with significant improvement in pain. PSF seems better treatment in patients with MC Type I.

Keywords: *Laminectomy, low back pain, modic changes, outcome, posterior spinal fusion*

Introduction

Modic changes (MC) are visible on magnetic resonance imaging (MRI) as lesions of the vertebral endplate and alterations in signal intensity of the bone marrow adjacent to a degenerated disc. There are three types of MCs, namely signs of bone marrow edema (Modic Type I), fat (Modic Type II), and osseous sclerosis (Modic Type III).[1,2]

Numerous studies have shown an association between MCs and chronic low back pain (LBP) and MC Type I had a stronger association than other MC types.[3-8] Chronic LBP is one of the leading causes of disability in adults.[9] The most frequent problem in LBP is degenerative disc disorder (DDD) which is also associated with MCs, especially Type I and II.[5,6,10]

Patients with chronic LBP with DDD and severe symptoms undergo different surgeries mainly spinal fusion. Studies have indicated that MC existence affects the outcome of surgery and levels of pain reduction.[11-14] Some studies have also reported satisfactory and high successful results following lumbar disc replacement or fusion in patients with MC especially type I MC.[15,16]

The studies in this regard are few, and still, we cannot make certain conclusions on the effects of the MC on surgery of chronic LBP outcome; also, there are few data available regarding the differences between different types of MC and surgery outcome. In this study, we aim to evaluate the effect of preoperative MC on the outcome of patients with LBP following posterior spinal fusion (PSF) or laminectomy.

Materials and Methods

Between January 2016 and February 2017, 162 patients with chronic back pain and disc extrusion or lumbar canal stenosis or spondylolisthesis candidate of surgery with MC Type 1 and II in MRI visiting neurosurgery clinics of Shohada-e-Tajrish Hospital, Tehran, Iran, were recruited for this study. All patients had MC Type I and II in MRI studies.

Inclusion criteria were patients between 20 and 70-year-old with axial pain, disc

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extrusion, lumbar canal stenosis, or spondylolisthesis not responding to medical therapy and MC Type 1 and II in MRI undergoing laminectomy or laminectomy with PSF. Patients with a history of trauma to spine, previous lumbar spine surgery, diabetes mellitus or other diseases causing neuropathy, rheumatologic, infectious, inflammatory or collagen vascular diseases, cardiovascular, pulmonary, and hepatic comorbidities that could affect the decision on the surgery type, global or regional deformity in spine including scoliosis, kyphosis, sagittal, or coronal imbalance were excluded. The study was approved by Ethics Committee of Shahid Beheshti University of Medical Sciences, and all patients gave written informed consent.

Patients' demographic findings, medical history, and duration of the disease were recorded. Pain intensity, before and 3 months after surgery, was evaluated using visual analog scale (VAS).

In our center, laminectomy and spinal cord decompression without PSF is performed for (1) disc extrusion with compression on spinal cord causing back pain or radicular pain, resistant to medical therapy or with neurologic deficits; (2) central or lateral lumbar canal stenosis, but no need for resection of more than half of the medial facet to decompress; (3) with no regional deformity or instability in spinal cord. Laminectomy and spinal cord decompression with PSF is the choice for cases (1) in need of discectomy in more than two adjacent levels because of the possible subsequent instability and increasing the back pain; (2) symptomatic spondylolisthesis in lumbar vertebrae with resistant medical therapy; (3) multilevel lateral recess stenosis in need of medial facetectomy; and (4) instability in need of surgical correction diagnosed in dynamic images before surgery. The standard operating procedure technique was followed in each surgery, and all surgeries were performed by a single neurosurgeon.

All patients underwent MRI of spinae before surgery. MCs are bone marrow and endplate lesions visible on MRI. We classified MC using the original classification by Modic *et al*.:[17]

- MC Type I: hypointense on T1WI and hyperintense on T2WI
- MC Type II: hyperintense on T1WI and isointense or hyperintense on T2WI
- MC MC Type III: hypointense on T1WI and hypointense on T2WI.

Statistical analysis

All data were analyzed using SPSS22 software (IBM SPSS Statistics Version 22, International Business Machines Corp., Armonk, NY, USA). Results are expressed as mean ± standard deviation or percentage. All normally distributed continuous data were analyzed using unpaired *t*-tests and expressed as the means and standard deviations. $P < 0.05$ was considered statistically significant.

Results

We studied 162 patients with chronic back pain and MC Type I and II before and after surgery. Patients underwent laminectomy (n = 72) or PSF (n = 90) surgeries. Patients had MC Type I in 75 (46.3%) (29 in laminectomy and 46 cases in PSF groups) and Type II in 87 (53.7%) (43 in laminectomy and 44 in PSF group). Pain score using VAS was significantly decreased following surgery (7.93 ± 1.27–5.98 ± 1.57, $P < 0.001$).

Patients' baseline findings with changes in pain severity are shown in Table 1. The only significant difference we observed was lower VAS 1 month after surgery in PSF group.

There was no difference in pain VAS score between MC Type I and II before (7.86 ± 1.32 vs. 8.00 ± 1.23, $P = 0.51$) and after treatment (5.89 ± 1.72 vs. 6.05 ± 1.44, $P = 0.51$). The mean VAS percentage of change also had no significant difference between MC Type I and II (−23.01 ± 26.63% vs.−22.54 ± 22.42%, $P = 0.90$).

We intended to compare the preoperative MC role in surgery outcome, so patients were evaluated separately in groups of Type I and Type II changes [Table 2]. Among MC Type I, there was a significantly more changes in pain score in PSF compared to laminectomy, but the changes in modic Type II were similar between groups.

Discussion

Previous studies have reported the associations between MC with disc degeneration, DD severity, and disc herniations.[5,18,19] MC is related to discogenic LBP[20] and they would be representative of an underlying pathology that should be a target for therapy.[21] These patients also have higher pain intensity than LBP patient without MC, which could also affect the surgical treatment outcome.

In this study, we evaluated the outcome of PSF and laminectomy in 162 patients with MC I and II and observed significant improvement in pain intensity following surgery. Previous studies have also reported significant improvement in pain score following surgical treatment.[22,23]

It is possible the surgical treatment improves patients' status regardless of MC. Chin *et al*.[24] reported no

Table 1: Patient's baseline findings with changes in pain severity after surgery

	Laminectomy	PSF	*P*
Age	53.54±8.57	55.77±9.72	0.12
Male sex (%)	37 (51.4)	51 (56.7)	0.50
Smoking (%)	32 (39.5)	25 (30.9)	0.24
VAS before	7.93±1.31	7.94±1.25	0.94
VAS after	6.27±1.44	5.74±1.63	0.03
VAS changes (%)	−18.69±23.25	−26.01±24.91	0.058

VAS – Visual analog scales; PSF – Posterior spinal fusion

Table 2: Pain score using visual analog scales before and after surgery between different types of modic changes

	Modic Type I			Modic Type II		
	Laminectomy	PSF	*P*	Laminectomy	PSF	*P*
VAS before	7.55±1.42	8.06±1.23	0.10	8.18±1.18	7.81±1.28	0.16
VAS after	6.31±1.51	5.63±1.80	0.09	6.25±1.41	5.86±1.45	0.20
VAS changes (%)	−13.49±25.51	−29.01±25.80	0.01	−22.20±21.17	−22.87±23.82	0.89

VAS – Visual analog scales; PSF – Posterior spinal fusion

significant difference between patients with and without MC in microdiscectomy outcome, but found a higher tendency for better improvement in those without MC. Sørlie *et al*.[14] observed that patients with MC type I would have lower improvement compared to other types of MC or those without MC, although the improvement is significant. Thus, Lurie *et al*.[25] indicated that MC Type 1 may be predictors of surgical treatment.

We compared the pain VAS before and after treatment between MC I and II and found no significant difference between groups. Similar to our findings, Ghodsi *et al*.[22] in their study on the efficacy of posterolateral fusion in patients with unstable lumbar spine with MC also observed no significant difference in surgical outcome between different types of MC. In another study, Yu *et al*.[23] found no difference in surgical outcome among patients with different modic types in patients with disc degeneration and MC.

Although Kwon *et al*.[15] reported significant improvement in pain VAS after treatment in both MC Type I and Type II, in their study, two types were not compared. Esposito *et al*.[26] also evaluated the effect of lumbar fusion in patients with chronic discogenic LBP. They observed significant improvement in pain in MC Type I, but there was no significant improvement in patients with MC Type II. However, they did not compare the difference in improvement between groups.

It is reported that MC Type I changes make patients more prone to spinal segmental instability than MC Type II.[27] Eser *et al*.[28] have also concluded that MC Type I is indicative of an ongoing active degenerative and inflammatory process, while MC Type II is representative of more stable and chronic process. They suggested that posterior dynamic stabilization could be an effective treatment in MC Type I. Similarly Vital *et al*.[29] reported conversion in MC Type I to Type II or normal following posterolateral fusion.

We also observed that among patients with Type I changes, PSF had significantly better improvement in pain score compared to laminectomy, while among Type I patients, the improvement was comparable. This is indicative of the better efficacy of PSF in MC Type I.

Conclusion

Surgical treatment in patients with LBP with MC accompanies with significant improvement in pain. PSF seems better treatment in patients with MC Type I.

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Conflicts of interest

There are no conflicts of interest.

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