Role of Lumbar Fusion in Modic Degenerative Changes Type 1

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ABSTRACT

Background: Modic changes (MC), which are categorized into three kinds based on their MRI signal patterns, are degenerative alterations of the vertebral end plates and surrounding bone marrow that are frequently linked to lumbar spine degenerative disc disease (DDD). Because of the mechanical failure and structural alterations that are most noticeable in the area of the extremely pain-sensitive intervertebral endplates, MC are implicated in the development of low back pain (LBP). **Objective:** We examined how treating lumbar disc herniation patients with preoperative MR images demonstrating MC type I affected the management of postoperative LBP and functional outcome when fusion was added to simple discectomy.

Methods: This retrospective study was conducted upon 15 patients at Beni-Suef University Hospital between March 2023 and March 2024. We evaluated the results of 15 patients who had lumbar intervertebral disc herniation-related LBP and sciatica surgically treated, together with the concurrent presence of MC type I in the preoperative MRI. Patients underwent posterior spinal fusion (PSF) and laminectomy. Preoperative MRI was used to establish the MC Type. Before and three months following surgery, the VAS was used to gauge the level of discomfort.

Results: The study was conducted upon 15 patients whose ages were between 30-65 years old with a mean 45.5. The study included 9 males and 6 females. LBP was the most common presenting symptom in all participants, followed by sciatica or claudication pain in 83.3%. Changes in VAS from before to after surgery were recorded. Results showed a statistically significant improvement in back pain after surgery when comparing preoperative VAS values using a paired student-t test, with a p-value of less than 0.001 for both sets of data. **Conclusion:** Surgical therapy for LBP with MC type I leads to considerable pain relief. PSF seems to be a superior therapy for patients with MC type I. **Keywords:** LBP, MC, VAS, PSF.

INTRODUCTION

Eighty percent of individuals will experience LBP at some point in their lives. A major contributing factor to LBP is lumbar degenerative disc disease (DDD). The complicated interaction between the disc, vertebral body, end plates, and facet joints, as well as each of their distinct functions in the pathophysiology of LBP, have drawn a lot of interest since the invention of MRI ⁽¹⁻³⁾.

Because of its abundance of neuronal components, the endplate may cause discomfort. MC and endplate lesions (Schmorl's nodes, fractures, erosions, and calcifications) are the two primary areas of endplate study. Therefore, the mechanical failure and structural alterations found in the area of the very pain-sensitive intervertebral endplates might implicate MC in the creation of such pain ⁽⁴⁻⁶⁾.

MC was initially identified by Modic in 1988 and is diagnosed on MRI as changes in bone marrow signal intensity at the spine endplate next to an abnormally deteriorated disc. These alterations mirror the inflammatory alterations that occur near degenerated discs and are brought on by the accumulation of inflammatory fibrovascular tissues in endplatedefective regions. MCs are classified into three types: Bone marrow edema (Modic Type I), fat (Modic Type II), and osseous sclerosis (Modic Type III) ⁽⁷⁾. Back discomfort that persists after lumbar discectomy is typically ascribed to the segment's alleged hypermobility, although the impact of the strained, deteriorated endplates has been mistakenly disregarded. As a result, the surgical management of mostly axial pain resulting from degenerative lumbar disc degeneration remains controversial; particularly in MC

type I patients⁽⁷⁾. We examined how treating lumbar disc herniation patients with preoperative MR images demonstrating MC type I affected the management of postoperative LBP and functional outcome when fusion was added to simple discectomy.

PATIENTS AND METHODS

This retrospective study was conducted upon 15 patients at Beni-Suef University Hospital between March 2023 and March 2024. We evaluated the results of 15 patients who had lumbar intervertebral disc herniation-related LBP and sciatica surgically treated, together with the concurrent presence of MC type I in the preoperative MRI. Patients underwent posterior spinal fusion (PSF) and laminectomy. Preoperative MRI was used to establish the MC type. Before and three months following surgery, the VAS was used to gauge the level of discomfort.

Patients' demographic information, preoperative VAS of LBP, symptoms at the time of operation, and preoperative radiographs, including dynamic X-rays and MRI, were all included in the data collection. These were used to document the existence of MC and rule out any instability.

Inclusion criteria: Individuals with a single level lumbar disc herniation with MC type 1 as shown by MRI who were between the ages of 18 to 70.

Exclusion criteria: Patients under the age of 18 or above 70 years old, had anatomical signs of instability as spondylolisthesis or fracture pars, had global or regional spinal deformities, such as kyphosis or scoliosis, prior lumbar spine surgery, or a history of spinal trauma. However, patients with incomplete 1year post-operative data and those with preoperative radiographic indications of instability were also disqualified. Comorbidities that might influence the choice to have surgery included DM or other conditions that cause neuropathy, rheumatologic, infectious, inflammatory, or collagen vascular illnesses, as well as cardiovascular, pulmonary, and hepatic conditions.

Records were kept of the patients' demographic information, medical background, and illness duration. Using VAS, the following grades were used to assess pain severity before and three months post-surgery. No pain was given zero score, mild pain was at score 1, 2, and 3, moderate pain at score 4, 5, 6, and 7 and severe pain: 8, 9, and 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 lumobosacral spine with MC appeared in single level. Patients then were assessed for VAS for the back pain in the immediate postoperative period and after 3 months.

Ethical Considerations:

Beni-Suef University Faculty of Medicine's Ethics Committee gave its approval to the project. Coded information was used to capture and evaluate participant data without any personal identities. Each center's source papers and identity lists were stored in a safe location. The investigator documented permission to access data. Each participant completed a permission form when all information was received. Throughout its implementation, the study complied with the Helsinki Declaration.

Statistical analysis

IBM Inc., Chicago, implemented statistical analysis using SPSS version 26.0. ANOVA with post hoc Tukey test was applied for comparing quantitative variables among the three groups. The variables were represented by their mean values and standard deviations. Qualitative variables were presented as frequency and percentage. A P value less than 0.05 in a two-tailed test signified a statistically significant result.

RESULTS

Demographic data: Out of 15 patients, 9 patients were males. The mean \pm SD age was 45.50 ± 9.80 (Table 1).

 Table (1): Sex and age distribution

| | | No. | (%) |
|-----|------------|---------|---------|
| | Male | 9 | 60% |
| Sex | Female | 6 | 40 % |
| | Mean± SD | Minimum | Maximum |
| Age | 45.50±9.80 | 30.00 | 65.00 |

Clinical manifestations: Regarding the 15 studied patients, LBP was the most prevalent presenting

complaint across all participants, followed by claudication pain in 73.3% (Table 2).

Table (2): Clinical presentation

| Clinical presentation | | No. | % |
|-----------------------|------------------|-----|-------|
| | Mild | 0 | 0.0% |
| | Moderate | 7 | 46.7% |
| LBP | Severe | 8 | 53.3% |
| | Yes | 11 | 73.3% |
| Claudication | No | 4 | 26.7% |
| | Yes | 10 | 66.7% |
| Sciatica | No | 5 | 33.3% |
| Motor power | Full Motor Power | 14 | 93.3% |
| preoperative | Has weakness | 1 | 6.7% |
| Urinary | Yes | 1 | 6.7% |
| manifestations | No | 14 | 93.3% |

Regarding the radiological findings: MC were predominantly located at level L4-5 (46.67%) followed by L5-S1, L3-4 level (36.67%) and (16.67%) regarding the type I MC (Figure 1).



Figure (1): Modic change in the affected levels.

Pain VAS improved immediately postoperatively after laminectomy with PSF as in table (3). Operative details are shown in table 4.

| Table (3): | Pain | outcome |
|-------------------|------|---------|
|-------------------|------|---------|

| Modic | | | | | | Р |
|-------------|------|------|--------|---------|---------|-------|
| Changes = | | | | | | value |
| Type I | Mean | SD | Median | Minimum | Maximum | |
| VAS Pre | 7.29 | 0.76 | 7.00 | 6.00 | 8.00 | 0.945 |
| AS | 2.29 | 0.76 | 2.00 | 1.00 | 3.00 | 0.051 |
| immediately | | | | | | |
| post | | | | | | |
| VAS 3 | 1.14 | 0.69 | 1.00 | 0.00 | 2.00 | 0.008 |
| months post | | | | | | |

 Table (4): Operative details results

| Intraoperative blood loss | 353.6 ± 244.93 ml | |
|---------------------------|------------------------|--|
| Operative time | 166.2 ± 24.84 min. | |
| Hospital stay | 4.12 ± 1.33 day | |

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Figure (2): Pre-operative Sagittal MR images (T2-weighted image (left) and T1-weighted image (right)) for a patient with L4-5 disc herniation associated with type I MC. The patient underwent discectomy with fusion with removal of the caudally migrated disc fragment. CT and follow up.

DISCUSSION

It has been shown that the vertebral end-plate, which acts as a bridge between the stiff vertebral body and the resilient intervertebral disc, is crucial for a healthy spine, and that degenerative spinal diseases are linked to its failure ^[8,9].

MCs are changes in the vertebral endplates that show up in MRI signals. They are believed to signify calcification in the endplate and vertebral body (MC-3), fat degeneration (MC-2), and early inflammation (MC-1) ^[10,11].

Prior research has documented the correlations between MC and disc herniation, DD severity, and disc degeneration. MC is associated with discogenic LBP and would be indicative of a pathology that should be the focus of treatment. Additionally, compared to LBP patients without MC, these patients have more intense pain, which may have an impact on the results of surgical therapy. Nonetheless, there is ongoing debate on the impact of MC on the clinical results of various treatment approaches ^[12-14].

In the current study, we wanted to evaluate how treating lumbar disc herniation patients with preoperative MR images, demonstrating MC type I, affected the management of postoperative LBP and functional outcome when fusion was added to simple discectomy.

Demographic data: Out of 15 patients, 9 patients were males with a total percentage of 60% that was more than female patients who represented 6 from the total number of patients with a total percentage of 40%. The age distribution of patients studied was between a minimum of 30 years old and maximum of 65 years old with a mean (\pm) SD is 45.50 (\pm) 9.80. These results were matching reports of similar studies like the study of **Bajpai** *et al.* ^[15] and the study of **Djurasovic** *et al.* ^[16] and the study of **Motiei-Langroudi and Sadeghian** ^[17]; all showed result similar to our demographic results.

In our study, MC were predominantly located at level L4-5 (46.7%) followed by L5- S1, L3-4 level (36.7%) and (16.7%) respectively. Similar to many other studies, like those of **Udby** *et al.* ^[14] **and Hu** *et al.* ^[18] **and the study of Jensen** ^[19]; all showed close results to our study.

We recorded the preoperative and postoperative (VAS) values and monitored them over the postoperative periods after evaluating the results of PSF and laminectomy in 15 patients with MC I. We found a substantial improvement in pain intensity after surgery. Pain VAS improved right after surgery in type I MC. Considering intraoperative blood loss mean, it was 353.6±244.93 ml and Op. time mean was 166.2±24.84 min. Hospital stay mean time was 4.12±1.33 days.

Additionally, prior research has documented a noteworthy improvement in pain scores after surgery, such as the results recorded by **Ghodsi** *et al.* ^[20].

Chin *et al.* ^[9] found patients with and without MC did not significantly vary in their microdiscectomy outcomes; however, those without MC tended to improve more. After microdiscectomy, **Sørlie** *et al.* ^[13] found that although the improvement is substantial, individuals with MC type I would see less improvement than those with other forms of MC or those without MC. Accordingly, MC Type 1 may be a predictor of surgical therapy, according to **Lurie** *et al.* ^[8].

Despite reporting a noteworthy improvement in pain VAS following therapy for both MC Type I and Type II, **Kwon** *et al.*^[21] did not compare the two kinds in their research. The impact of lumbar fusion in individuals with persistent discogenic LBP was also assessed by **Esposito** *et al.*^[22]. Patients with MC type I showed a notable reduction in pain, whereas those with MC type II showed no discernible improvement. They did not, however, compare how much each group had improved.

For patients with MC, spinal fusion was advised by **Ghodsi** *et al.* ^[20] and **Eser** *et al.* ^[23] only in cases when instability coexisted. In order to stimulate and speed up the healing of the inflammatory process that occurs in the vertebral end-plates, **Vital** *et al.* ^[24] advised posterior fusion exclusively for patients with type I MC, ignoring advantages for type II. According to reports, individuals with MC type I alterations are more likely than those with MC type II changes to experience spinal segmental instability.

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 personnel 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 LBP and would be indicative of an underlying pathology that should be treated. These patients also have more intense LBP 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 on patients with back pain due to de generative disc disease following laminectomy with PSF. We observed that surgical treatment in those patients is accompanied with significant improvement in pain. PSF seems to be a better treatment in pain of such cases.

Conflict of interest: None. **Financial disclosures:** None.

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