Comparison of Treatment Outcomes in Nonspecific Low-Back Pain Patients With and Without Modic Changes Who Receive Chiropractic Treatment

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Abstract

Objective: The aim of this study was to determine if there was a difference in outcomes in patients with nonspecific low back pain, both with and without Modic changes (MCs), who received chiropractic care.

Methods: This prospective outcomes study included 112 patients with low back pain without disc herniation on magnetic resonance imaging. All patients were treated with spinal manipulative therapy. At baseline, the numerical rating scale (NRS) and Bournemouth Questionnaire (BQ) for disability were collected. The NRS, BQ, and Patient's Global Impression of Change (primary outcome) were collected at the follow-up time points of 1 week, 1 month, and 3 months to assess overall improvement. Magnetic resonance imaging scans were analyzed for the presence of MCs and, if present, classified as Modic I or II. The χ^2 test was used to compare the proportion of patients reporting clinically relevant "improvement" between patients with and without MCs and between Modic I and Modic II patients. The unpaired Student *t* test was used to compare NRS and BQ at baseline and change scores at all follow-up time points.

Results: For the primary outcome measure, the proportion of patients reporting relevant "improvement" (Patient's Global Impression of Change), and for the secondary outcome measures (NRS and BQ change scores), there were no significant differences between Modic positive and Modic negative patients or between Modic I and Modic II patients.

Conclusion: Neither the presence nor absence of MCs nor the Modic change category were related to treatment outcomes for patients with low back pain without disc herniation who received chiropractic care. (J Manipulative Physiol Ther 2018;41:561-570)

Key Indexing Terms: *Diagnostic Imaging; Chiropractic; Outcome Assessment (Health Care); Manipulation, Spinal*

Introduction

Modic changes (MC) categorize 3 types of degenerative abnormalities in the bone marrow around the vertebral endplates and are visible on magnetic resonance imaging (MRI).[1] They are most common in the lumbar spine and are associated with degenerative disc disease at the same level of involvement.[1] The combination of low-signal intensity on T1-weighted sequences and high-signal intensity on T2-weighted sequences is named MC type I and represents bone marrow edema.[1-3] The appearance of high-signal intensity on both T1-weighted and T2-weighted sequences corresponds to Modic type II changes, the same as fat. Modic type III changes are shown as low-signal intensity on both T1-weighted and T2-weighted sequences and would appear as sclerosis on routine radiograph.[1,4-6] Many studies have already shown that the incidence of MC increases with age[4,7] and that MC tend to convert to other types over time, mostly type I to type II.[8-10]

The role of MCs in the lumbar spine as pain generators is currently well known,[11-15] especially regarding the activity of MC type I. It is also well known that patients with disc herniations are more likely to have MCs at the level of herniation.[16-19] In recent years, many studies have evaluated the effects of different types of treatment on MC and how patients with MC respond to various treatments.[2,20-27]

The effect of invasive treatments on patients with low back pain (LBP) was recently studied by Lee et al.[25] They evaluated the outcome predictors of lumbar transforaminal epidural steroid injection in patients with radiculopathy owing to a herniated intervertebral disc (HIVD). They showed that the only good MRI-based predictor for improvement was the location of the HIVD. The HIVDs in the foraminal or in

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the extraforaminal zone were significantly more common in the very best outcome group than HIVDs in the central or in the subarticular region. Other MRI findings, such as grade of disc degeneration, disc height loss, or MCs, were not statistically significant in predicting good or bad outcomes from steroid injections.

In 2014, a study by Peterson et al[27] evaluated the outcomes of patients presenting with LBP caused by an MRI-confirmed symptomatic disc herniation with and without MCs who received an imaging-guided transforaminal lumbar nerve root block. Patients with an MRI-confirmed, symptomatic lumbar disc herniation who exhibited MC were less likely to improve after the lumbar nerve root block compared with patients without MC. However, although the presence of MC was related to less improvement, the differences in outcome between patients with and without MC did not reach statistical significance, even though the sample size was quite large.

In 2015, Bianchi et al[26] reported on the outcomes of lumbar therapeutic facet joint injections in patients with and without lumbar MC. Although there was a tendency for MC negative patients to do better after lumbar facet injections, the results once again showed no statistically significant difference between the 2 groups. The MCs were not significantly related to improvement in that study.

Few studies analyzed the effect of conservative treatment on patients with MCs and associated degenerative changes or disc herniations. One of the most recent studies on the subject found that a spontaneous resorption of a disc herniation is less likely when MCs are present. Therefore, the presence of MC may be associated with a poorer outcome in conservative treatment.[23]

The effect of high-velocity, low-amplitude chiropractic manipulation on acute and chronic LBP owing to a disc herniation was studied by Leemann et al[24] in 2014. In this study, the majority of acute and chronic disc herniation patients treated with spinal manipulation reported a clinically relevant improvement in the short and in the long term. However, a comparison of outcomes based on specific MRI findings, including MCs, was not done at that time. A follow-up study on a subgroup of these patients evaluated whether or not specific MRI findings were related to treatment outcomes, including the presence or absence of MCs.[4] This showed that patients with MCs and disc herniation responded well to spinal manipulation, especially when MC type II was present.[4] To date, no studies have been reported that compared treatment outcomes from other LBP patients receiving high-velocity, low-amplitude spinal manipulation with and without MCs.

To the authors' knowledge, at the current time point, the studies regarding the outcomes of patients having MC and receiving conservative treatment were few, and the results were controversial. Therefore, the purpose of this study was to determine if there is any difference in outcomes in patients with nondisc herniation LBP, with and without MCs, who present to a university hospital–based chiropractic teaching clinic and receive chiropractic treatment.

Materials and Methods

Patients

This prospective outcomes study included consecutive adult patients presenting with LBP without disc herniation to the outpatient teaching clinic of the chiropractic medicine department within a specialized, university-based musculoskeletal hospital. All of the patients had an MRI scan within 3 months of symptoms presentation, which was negative for the presence of disc herniation.

The patients received chiropractic treatment in a single center where sixth-year chiropractic medicine students were practicing under supervision. The treatments and treatment numbers were not standardized but left to the discretion of the supervising chiropractor. However, it is known that the most common treatment used by Swiss chiropractors is the Diversified technique.[24] The MRI scan findings and clinical outcomes of 112 patients were collected and included in this study. Baseline demographic information and clinical outcomes for all included patients were available on the clinic database. However, all MRI scans were read blinded to the baseline and outcome data.

The inclusion criteria for this study were patients aged between 18 and 65 years, LBP, and a negative MRI scan for lumbar disc herniation. Patients presenting with pathologies that are considered contraindications for chiropractic treatment, such as tumors, infections, inflammatory spondylarthropathies, acute fractures, Paget's disease, and severe osteoporosis, were excluded from this study. Patients with previous spinal surgery, signs of cauda equina syndrome, neurogenic claudication, spondylolisthesis, pregnancy, and body mass index over 30 were also excluded.

Ethics

This study received ethics approval from the local ethics committee (Canton of Zürich EK-16/2009), and all patients signed an informed consent to participate in the study.

Treatment Procedure

The chiropractic treatment was performed by supervised chiropractic final year (sixth-year) students working in the chiropractic outpatient clinic at the specialized musculoskeletal hospital at the time of data collection. The treatment consisted of a specific high-velocity, low-amplitude spinal manipulation at the level of pain for most patients and in the application of passive therapies, such as cold application and muscular techniques. The area of spinal dysfunction was determined using palpation for bony and soft tissue pain and segmental motion palpation for dysfunction of the lumbar region of the spine.

Outcomes Measures

Patients who met the inclusion criteria completed pain and disability questionnaires at baseline before the first

chiropractic treatment. They also completed the same questionnaires about pain and disability levels at specific outcome time points. In addition, at the follow-up time points, they were also asked to score their impression of overall improvement.

At baseline, pain level and disability data were collected before the first chiropractic treatment. The numerical rating scale (NRS) of 0 to 10 (0 = no pain; 10 = the worst pain imaginable) and the Bournemouth Questionnaire (BQ), a self-report questionnaire about subjective pain and disability specific for LBP patients that also includes cognitive and affective aspects of pain, were used. At the time points of 1 week, 1 month, and 3 months follow-up, pain data (NRS), disability data (BQ), and the data about the impression of overall improvement using the Patient's Global Impression of Change (PGIC) scale were collected. The data were collected via telephone interviews or online questionnaires, depending on the patient's preference, by research assistants unknown to the patients.

The impression of overall improvement of patients was collected using the PGIC (primary outcome measure). The PGIC scale ranges from 1 to 7, with 1 meaning "much better" and 7 meaning "much worse" ("much better," "better," "slightly better," "unchanged," "slightly worse," "worse," "much worse"). In this study, as in previous studies,[4,24] only a score of 1 or 2 was considered as clinically relevant "improvement" in the patient's condition. "Slightly better" was not considered an improvement, and the scores from 5 to 7 were all considered a "worsening" of the patient's condition.

The primary outcome of this study was the proportion of patients reporting a clinically relevant improvement on the PGIC scale, whereas the secondary outcomes were the NRS, the BQ, and the worsening of patient's condition.

Demographic information about patient's age, sex, and duration of symptoms was collected before the first treatment by the chiropractic final year student.

MRI Evaluation

The MRI of 112 patients presenting with LBP, demonstrating no disc herniation and no previous spinal surgery, whose demographic data at baseline and outcome data at the 3 different time points were available, were included in this study. The MRI scans were performed within 3 months of complaint presentation.

All of the patients underwent MRI scans, including sagittal and axial slices, and the evaluation was based on T1-weighted, T2-weighted, and fat-suppressed short TI inversion recovery slices.

The MRI scans were evaluated in consensus by 2 readers, a master's student in chiropractic medicine and the supervisor (radiologist and chiropractor), without the knowledge of the clinical outcomes of the patients. The aim of the evaluation of the lumbar segments from L1 to L2, to L5 to S1 was to determine the presence or absence of MCs and, if present, to determine the type of MC, I or II. Modic change type III was not considered. If mixed MC type I and II were present, MC type I was prioritized.

Previous studies have already confirmed the inter-rater and intrarater reliability of identifying and categorizing MCs on MRI scans (Figs 1 and 2).[26,28]

Statistical Analysis

The statistical analysis for the primary outcome, the proportion of patients reporting a clinically relevant improvement in the PGIC scale, was as follows. The patients were categorized as "improved" if they answered with a 1 or a 2 ("much better," "better") on the PGIC scale, and as "not improved" if they had a score of 3, 4, 5, 6, or 7 ("slightly better" through "much worse"). The percentage of "improved" and "not improved" patients was calculated for each time point. Then the percentage of patients reporting clinically relevant "improvement" was compared first for the presence or absence of MCs (both types I and II together) and second for the specific Modic categories (0 = absence of MC; 1 = MC type I; 2 = MC type II) for every follow-up time point (1 week, 1 month, 3 months). These relationships were compared using the χ^2 test. The scores of 5, 6, and 7 ("slightly worse" to "much worse") were categorized as "worsening." The percentage of patients reporting "worsening" was also calculated for each time point and compared between Modic positive and negative patients as well as between Modic I and II patients, using the χ^2 test.

The change scores (normally distributed data) for the secondary outcomes (NRS and BQ) for patients with and without MC were compared for significant differences ($P < .05$) at every follow-up time point using the unpaired Student *t* test. The same procedure using the unpaired Student *t* test was also done for comparing NRS and BQ change scores for patients with different MC type (I and II) at all follow-up time points. Comparisons between data (ie, change scores) were always made referring to the baseline scores.

Results

From the database of the chiropractic outpatient clinic, 112 consecutive adult patients with LBP, no lumbar disc herniation, and who received chiropractic treatment (usually high-velocity, low-amplitude spinal manipulation) were included. For every patient, demographic data and an MRI scan, negative for lumbar disc herniation and done within 3 months from the presentation of symptoms, were available. This sample of patients was then divided into 2 groups, 1 included the patients presenting with MCs in the MRI scan (57 patients), and 1 included the patients without MC (55 patients). Of the patients presenting with MC, 28 were categorized as MC type I and 29 as MC type II.

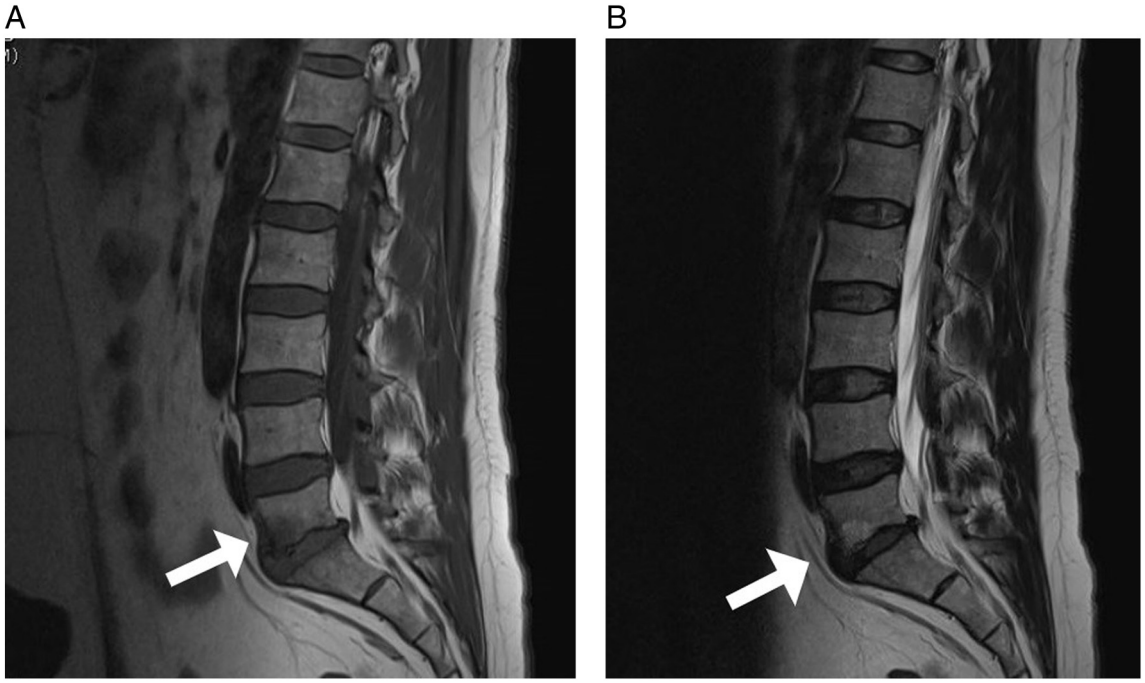

Fig 1. *Magnetic resonance imaging of the lumbar spine, sagittal slices, T1-weighted (A) and T2-weighted (B), showing a Modic change type I at the lower anterior corner of L5 and slightly on the upper anterior corner of S1.*

The age range was between 18 and 81 years old, with a mean age of 45.28 years (standard deviation [SD] = ±16.182). Of the included patients, 58% were male and 42% were female. There was a statistically significant difference in patient ages comparing MC positive and negative patients. The mean age of patients with MCs was 51.93 (SD = ±14.57) compared to 37.74 (SD = ±14.29) for patients without MCs (P = .0001). No statistically significant difference in patient ages was found when comparing Modic I (50.71 [SD = ±14.88]) and Modic II (53.10 [SD = ±14.42]) patients, however (P = .54).

The patients were also categorized into 3 groups based on the chronicity of the symptoms: patients with LBP < 4 weeks were categorized as acute, patients with LBP between 4 weeks and 3 months as subacute, and patients with LBP more than 3 months as chronic. Of this sample, 75.9% of the patients (N = 85) were categorized as chronic, 12.5% (N = 14) as acute, and 10.7% (N = 12) as subacute.

There were no significant differences between Modic positive and negative patients or between Modic I and II patients for baseline NRS or BQ total scores (Tables 1 and 2). There were also no significant differences between Modic I and II patients for any of the 7 specific domains of the BQ at baseline. However, statistically significant differences were found when comparing Modic positive and Modic negative patients for responses on both the anxiety and depression domains (items 4 and 5) of the BQ at baseline. The Modic negative patients had a mean score of 6.25 (SD = ±2.80) compared with 5.12 (SD = ±3.01) for the Modic positive patients (P = .047) for anxiety. For depression, the Modic negative patients had a mean score of 5.68 (SD = ±3.27), whereas the Modic positive patients had a mean score of 4.32 (SD = ±3.46) (P = .034).

The primary outcome of this study was the percentage of patients reporting a clinically relevant "improvement" at the various follow-up time points using the χ^2 test. As shown in Table 3, there was no statistically significant difference regarding "improvement" or "worsening" of the patients' reported condition between the MC positive and the MC negative group at any of the collection data time points.

The χ^2 test was also used to compare MC type I and MC type II patients at all outcome time points. Table 4 shows that there was no statistically significant difference in the proportion of patients reporting "improvement" or "worsening" when comparing MC I and MC II patients at any follow-up time point.

Table 1 compares patients with and without MC for baseline characteristics and for NRS and BQ change scores at every data collection point, and Table 2 shows the comparison between MC type I and MC type II patients for baseline data and for NRS and BQ change scores. Although the Modic negative patients showed higher BQ change scores at every follow-up time point, it did not reach statistical significance. There was no significant difference between MC positive and MC negative patients nor

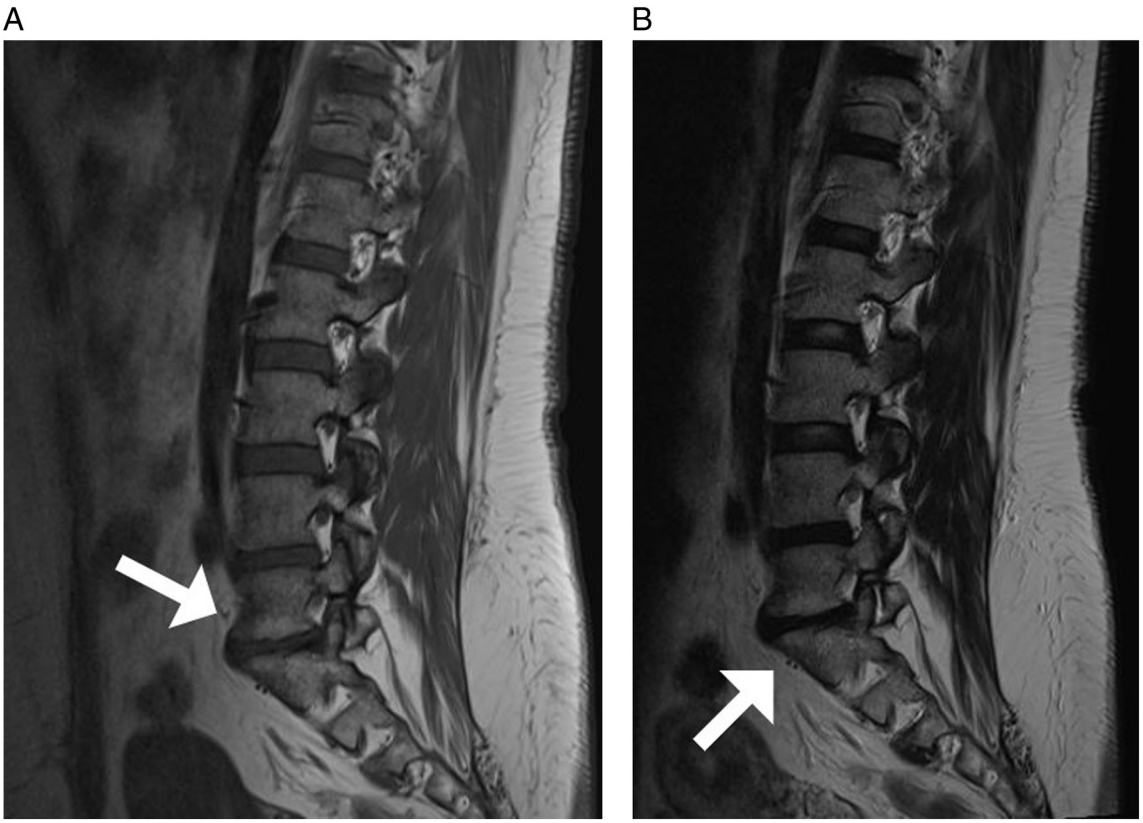

Fig 2. *Magnetic resonance imaging of the lumbar spine, sagittal slices, T1-weighted (A) and T2-weighted (B), showing a Modic change type II at the lower vertebral endplate of L5 and at the upper vertebral endplate of S1.*

between MC I and MC II patients for the NRS or BQ change scores at any outcome time point.

Discussion

The aim of this prospective outcome study was to compare the treatment outcomes of patients with and without MCs presenting with LBP, a negative MRI scan for lumbar disc herniation, and who received chiropractic treatment, including high-velocity, low-amplitude spinal manipulation, in a single center, chiropractic outpatient clinic at a specialized musculoskeletal hospital. To the authors' knowledge, this study is one of the few showing the role that the presence of MC could play in the conservative treatment of nonspecific LBP.

Comparing MC positive with MC negative patients and MC I with MC II patients, we did not find any significant differences in the proportion of patients who reported clinically relevant "improvement" in their condition and those who did not at any data collection time point. The percentage of patients reporting clinically relevant "improvement" increased in all categories (MC present or absent, MC I or MC II) over time. This means that the presence of MC or of a certain MC category did not influence the outcome of the patients undergoing chiropractic treatment.

Compared with a previous study on this subject, which included only patients with symptomatic, MRI confirmed disc herniation,[4] this current study on nondisc herniation patients showed a lower proportion reporting clinical relevant "improvement" of their condition over time. For example, after 3 months, in the previous study, 80% of patients with MC I were improved," whereas in this current study only 52.2% of MC I patients in the same chronicity category reported "improvement." This is most likely due to the much higher number of chronic patients included in this current study and less likely to be related to the presence or absence of a certain type of MC. In the previous study, at the 3 months follow-up time point, more than 80% of the patients reported clinically relevant "improvement," irrespective of the MC category, whereas in this current study, between 50% and 58% of patients were "improved," depending on the MC category. The percentage of chronic patients in this current study was 75.9% compared with only 26% chronic patients in a study on disc herniation patients.[4]

Comparing the baseline scores of NRS for back pain and of the BQ for pain and disability with the presence or absence of MC did not find any significant differences. The

Table 1. *Student* t *Test Comparing Modic Positive and Modic Negative Patients for Baseline and Change Scores of NRS and BQ at the Various Data Collection Time Points*

	Modic Change	N	Mean Value	Standard Deviation	*P* Value
Baseline scores					
NRS Back	Yes	56	5.50	2.64	.971
	No	54	5.52	2.69	
BQ	Yes	57	38.73	16.20	.215
	No	54	42.57	16.28	
Change scores					
NRSChng1Wk	Yes	48	0.28	1.87	.895
	No	46	0.34	2.21	
NRSChng1Mth	Yes	44	0.81	3.22	.789
	No	35	0.99	2.56	
NRSChng3Mths	Yes	46	1.33	2.96	.857
	No	32	1.20	2.93	
BQChng1Wk	Yes	45	4.95	9.89	.581
	No	45	6.23	11.99	
BQChng1Mth	Yes	44	6.23	16.40	.132
	No	35	11.67	14.94	
BQChng3Mths	Yes	48	11.89	15.05	.283
	No	32	15.76	16.54	

BQ, Bournemouth Questionnaire; *Chng*, change score (baseline – follow-up score); *NRS*, numerical rating scale for pain.

Table 2. *Student* t *Test Comparing Modic I and Modic II Patients for Baseline and Change Scores of NRS and BQ at the Various Data Collection Time Points*

	Modic Category	N	Mean Value	Standard Deviation	*P* Value
Baseline scores					
NRS Back	1	28	5.45	2.32	.881
	2	28	5.55	2.96	
BQ	1	28	38.89	15.23	.940
	2	29	38.57	17.35	
Change scores					
NRSChng1Wk	1	25	0.18	1.43	.700
	2	23	0.39	2.28	
NRSChng1Mth	1	22	0.25	2.58	.256
	2	22	1.36	3.74	
NRSChng3Mths	1	23	1.04	2.43	.523
	2	23	1.61	3.44	
BQChng1Wk	1	23	5.52	10.38	.698
	2	22	4.36	9.55	
BQChng1Mth	1	21	3.48	17.74	.293
	2	23	8.74	15.03	
BQChng3Mths	1	23	12.77	13.68	.703
	2	25	11.09	16.45	

BQ, Bournemouth Questionnaire; *Chng*, change score (baseline – follow-up score); *NRS*, numerical rating scale for pain.

same results were found when comparing the baseline scores of NRS and BQ with the different MC categories (MC I and MC II). This is surprising because it is known that especially MC I acts as a pain generator because of its inflammatory nature.[11-15] Thus, a higher baseline pain and disability score for patients presenting with an MC type I would be expected.

The results also show that the Modic negative patients have slightly higher BQ change scores at every outcome time point; although, it did not reach statistical significance. However, surprisingly, when comparing Modic I with Modic II patients, Modic I patients had higher BQ change scores at both 1 week and 3 months, although not statistically significant. If Modic I (bone marrow edema) is indeed a significant contributor to LBP, this should not have occurred.

These results support the hypothesis already illustrated in a previous study,[4] that the back pain is not generated only from the presence of MC or of a certain MC category, but it is more likely multifactorial in nature. The sole presence of MC (especially MC I) was not sufficient to explain the presence of back pain in those patients and should not be over emphasized in determining treatment. Certainly, the presence of MCs is not a contraindication for chiropractic treatment.

Many authors have already evaluated other, more invasive treatment methods for MCs, such as surgical procedures, antibiotic-based treatments, and lumbar steroid injections.[2,25-27,29-36]

The etiopathogeny of MCs has been evaluated by many studies,[10,37-40] especially regarding MCs type I. It was hypothesized that MCs type I were a consequence of repeated microtraumas, leading to segmental instability and

Table 3. *Proportion of Modic Positive and Modic Negative Patients Reporting Clinically Relevant "Improvement" or "Worsening" of the Pain Condition at the Data Collection Time Points of 1 Week, 1 Month, and 3 Months*

	Modic Present	Modic Absent	*P* Value
1 week			
Improved	20.8% (n = 10/48)	26.1% (n = 12/46)	.72
Worse	8.3% (n = 4/48)	17.4% (n = 8/46)	.31
1 month			
Improved	42.2% (n = 19/45)	44.1% (n = 15/34)	1.00
Worse	6.7% (n = 3/45)	17.6% (n = 6/34)	.24
3 months			
Improved	51.1% (n = 24/47)	58.1% (n = 18/31)	.71
Worse	4.3% (n = 2/47)	12.9% (n = 4/31)	.33

n = number of patients.

Table 4. *Proportion of Patients With Modic Change I and Modic Change II Reporting Clinically Relevant "Improvement" or "Worsening" of the Pain Condition at the Data Collection Time Points of 1 Week, 1 Month, and 3 Months*

	Modic Change I	Modic Change II	*P* Value
1 week			
Improved	20.0% (n = 5/25)	21.7% (n = 5/23)	1.00
Worse	4.0% (n = 1/25)	13.0% (n = 3/23)	.54
1 month			
Improved	40.9% (n = 9/22)	43.5% (n = 10/23)	1.00
Worse	9.1% (n = 2/22)	4.3% (n = 1/23)	.97
3 months			
Improved	52.2% (n = 12/23)	50.0% (n = 12/24)	1.00
Worse	0.0% (n = 0/23)	8.3% (n = 2/24)	.49

n = number of patients.

thus to the production of proinflammatory substances and local inflammation.[37-39] Furthermore, these studies confirmed the association between MCs and disc herniations, often found at the same vertebral level, possibly indicating a continuum in a dynamic degenerative disc disease.[10,39,40] These facts are supported by other studies,[29,30] which found that surgical stabilization of the involved vertebral levels could lead to pain relief in patients with MC I but not in patients with other MC types. A study by Ohtori et al[31] evaluated the changes that occurred in the lumbar spine after posterolateral fusion surgery and found a conversion to Modic type II in 9 patients and the disappearance of MC I in 2 patients. This could support the instability-hypothesis as a cause for Modic type I changes. Chataigner et al[32] reviewed 56 patients who underwent anterior lumbar interbody fusion and found the best results in patients presenting with MC I at baseline compared with patients with MC II, who had poorer results after surgery. On the other hand, another study that evaluated the surgical procedure of lumbar disc replacement did not find any difference in outcomes between patients with and patients without MC.[33]

At the current time point, there are no published studies about the natural history of MCs versus surgical procedures, so the changes of MC category or the disappearance of MC may not be completely attributed to the surgical treatment. Furthermore, there is no agreement on the best surgical procedure for MCs because different studies show different results.

Another hypothesis in the etiopathogeny of MCs type I is the bacterial infection. Some studies confirmed the presence of local disc infection in patients presenting with an MC type I in the adjacent vertebrae,[34,41] leading to the question if antibiotics could be a valid treatment for MCs. In recent years many authors have tried to evaluate the effect of antibiotics on MC type I, leading to controversial results. A recent study of Albert et al[34] found a significant improvement in the patients' symptoms after long-term antibiotics when compared with placebo, whereas Wedderkopp et al[35] found no evidence of bacterial infection in the biopsy of patients presenting with MC type I. A very recent trial published in 2017[36] included 28 patients with chronic LBP associated with MCs type I and no previous lumbar surgery, with all patients undergoing a long-term treatment based on the same antibiotic used in the previous trial of Albert et al. Disappointedly, the results could not confirm the infectious nature of Modic I changes because the outcomes were similar to those of follow-up studies regarding patients with MC type I who did not receive any antibiotics.[42] The authors of this second trial suggested that the difference in outcomes between these 2 studies was that on the first trial of Albert et al, half of the included patients had undergone previous discal surgery, leading to the development of a postsurgical infectious type of MC I. To date, a treatment based on antibiotics remains controversial, and the role of a low-grade infection as the cause of the MC type I needs further study because Modic I subsets, such as infection-induced or instability-induced, may exist and may need specific types of treatment.[38] Certainly, the results of this current study do not support infection as an etiology of Modic I changes, and these patients had very similar treatment outcomes compared with patients with Modic II changes or no MCs at all.

Another treatment procedure that was studied in recent years is the lumbar steroid injection. Two different studies[2,43] evaluated intradiscal steroid injection and

found that it could represent a valid short-term treatment in patients with therapy-resistant chronic LBP presenting with MC type I because these patients did significantly better compared with the patients with LBP and MC type II. These results are supported by another study,[44] which found that intradiscal steroid injection and epidural steroid injections were beneficial for a small group of patients and were more effective if inflammatory vertebral endplate changes were found.

Conversely, a recent study[25] evaluated the outcome predictors of lumbar transforaminal epidural steroid injection in patients with radiculopathy owing to a herniated disc and found that the only good outcome predictor was the location of the herniated disc and not the presence or absence of other MRI findings, such as MCs. Another study in patients receiving lumbar facet injections, which included corticosteroids as treatment for LBP, found no significant difference between patients with and without MCs.[26] Furthermore, a recent study by Peterson et al[27] found that the transforaminal nerve root block for the treatment of symptomatic lumbar disc herniations was slightly more effective in terms of pain reduction in patients without MC, although the difference in outcome did not reach statistical significance.

To date, only a few studies have evaluated the effect of more conservative treatments on patients with LBP presenting with MCs. The effect of chiropractic treatment on acute and chronic LBP owing to a herniated disc was studied in 2014 by Leemann et al,[24] with significant improvement in the patients' symptoms. A follow-up study included patients with LBP, lumbar disc herniation, with or without MCs, and evaluated if the presence of vertebral endplate changes could influence treatment outcomes.[4] This study showed that most patients responded well to the treatment, especially if MC II was present.

This current study supports the results of other studies on this subject in that chiropractic care is a safe and valid conservative treatment method not only in patients with a herniated disc, but also in patients presenting with a nonspecific type of LBP and MCs. Modic changes are not to be considered a contraindication for chiropractic treatment and are not related to a worse outcome.

Limitations

One of the main limitations of this study was that many parameters that are known to act as pain and disability perpetuating factors (eg, socio-economic status, educational level) were not considered.[45-47] The presence or absence of MC and the MC category was compared with the patients' clinical outcomes that included only a few psychological factors, such as anxiety and depression reported through the BQ for LBP. The fact that many other known predictors for chronicity in LBP were not considered in this current study could represent a problem in interpreting the results because most of the patients that were included in this study were categorized as chronic (75.9%), and the relationship between chronicity and these perpetuating factors is well known. Unfortunately, this information was not available for the included patients, making it impossible to determine if other, external factors were also playing a role in the reported "improvement" or "worsening" of the patients' condition. Surprisingly, however, Modic negative patients scored significantly higher on both anxiety and depression levels at baseline compared to Modic positive patients. These 2 factors are known to be related to less favorable outcomes,[45-47] yet this was not found in this study. This is surprising because on one hand depression is known to be a significant baseline predictor for the development of LBP chronicity and thus for a worse outcome in other studies,[45,46] yet in this current study, the patients with higher baseline scores for depression and anxiety did not have significantly worse treatment outcomes. On the other hand, MC type I is known to act as a pain generator, so a worse outcome of the MC I patients would be expected, yet it could not be supported by the results of this study. Furthermore, another study about chronicity predictors found only a weak association between moderate to severe MCs and an adverse outcome,[47] underlining once more the importance of other factors in the development of pain chronicity.

Another main limitation is the fact that this study was not designed as a randomized controlled trial but as a prospective outcomes study, so the results cannot be definitively attributed to the chiropractic treatment.

The relatively small sample size and the fact that this study considers only the follow-up until 3 months could represent additional limitations.

In addition, MRI scans after the last follow-up time point were not available, so it is impossible to say if the MCs remained stable over the 3-month time period or if they changed category from MC I to MC II or disappeared entirely, a fact that could have influenced the patients' conditions because of the known pain generating nature of MC I and less of MC II. Follow-up MRI scans would not be supported from the evidence-based imaging guidelines nor be cost-effective for the patients.

Conclusions

The presence or absence of MCs and the category of MC, when present, were not related to the outcomes for LBP patients without lumbar disc herniations who were undergoing chiropractic treatment. This calls into question the clinical relevance of particularly MCs I as a serious pain generator and certainly challenges the theory that MCs are due to infection.

These results are consistent with the ones found for lumbar disc herniation patients treated with high-velocity, low-amplitude spinal manipulation. This also supports the hypothesis that chiropractic care is a safe conservative treatment for patients presenting with nonspecific LBP, despite the presence of MCs.

Furthermore, the results of this study show that the sole presence of MCs is not sufficient in explaining back pain in these patients. More research on the multifactorial cause of LBP is needed.

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Contributorship Information

Concept development (provided idea for the research): C.P., B.K.H.
Design (planned the methods to generate the results): C.P., B.K.H.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): C.P., B.K.H.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): M.A., C.P.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): M.A., C.P.
Literature search (performed the literature search): M.A., C.P.
Writing (responsible for writing a substantive part of the manuscript): M.A., C.P.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): C.P., B.K.H.

Practical Applications

- Modic changes are not related to worse treatment outcomes in patients with low back pain and no disc herniations.
- Chiropractic care is a valid method for patients with low back pain despite the presence of Modic changes.
- The presence of Modic changes alone cannot explain low back pain.

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