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The Effect of Fusion Added to Lumbar Discectomy in Patients with Modic Changes: A Retrospective Comparative Outcome Analysis Regarding Back Pain Control

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ABSTRACT

Background Data: In 1988, Modic et al first described magnetic resonance (MR) degenerative changes in the lumbar vertebral bodies. changes in the intervertebral endplates, Modic Changes (MC) can also be incriminated in the production of such pain due to the mechanical failure and structural changes that can be detected the most in the region of the highly pain sensitive intervertebral endplates. There is still a controversy regarding the surgical treatment of the predominantly axial pain secondary to degenerative lumbar disc disease.

Study Design: This is a retrospective cohort study.

Purpose: To evaluate the effect of adding fusion to simple discectomy in treatment of patients of lumbar disc herniation that show evidence of MC on preoperative MR images regarding the control of postoperative back pain and functional outcome.

Patients and Methods: This study included 44 patients who underwent surgical management of low back pain and/or sciatica due to lumbar intervertebral disc herniation with concomitant presence of Modic changes in the preoperative MR images. Patients were divided into two groups: Group A (Discectomy group), and Group B (Fusion group). Patients included had single level lumbar disc herniation with modic changes. Patients with radiographic evidence of instability and patients whose 1-year post-operative data were incomplete were excluded. Twenty five patients were males and 19 were females with a mean age of 43.48 years. Nineteen patients (43.2%) were allocated in Group A and 25 patients (56.8 %) in Group B. Clinical results and functional outcome were assessed based on changes in preoperative and postoperative Visual Analogue Scale (VAS) of low back pain and Oswestry Disability Index (ODI) scores of the functional disability.

Results: Postoperative back pain improvement was statistically significant in both groups when comparing preoperative values of VAS using paired student-t test with $P<0.001$ for both groups. Comparison of post-operative back pain VAS for both groups using independent student-t test revealed a statistically

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non-significant difference with a P=0.239 (Mean VAS for group A=2.211 while mean VAS for Group B=1.48).

Conclusion: Unless otherwise indicated, simple lumbar discectomy without fusion is a reasonable surgical option in treatment of patients with lumbar intervertebral disc herniation even in the presence of Modic changes in their pre-operative MRI. (2018ESJ167)

Keywords: Modic changes; lumbar discectomy; low back pain; Lumbar fusion

INTRODUCTION

In 1988, Modic et al,[14] first described Magnetic Resonance (MR) of degenerative changes in the lumbar vertebral bodies. Since then, the term Modic changes (MC) has been used reliably to refer to the MR signal changes that can be detected in the vertebral endplates and the adjacent part of the vertebral body and can be strongly attributed to intervertebral disc disease.[10,11,21] These changes are a reflection for the inflammatory changes that take place close to degenerated discs and take place due to deposition of inflammatory fibrovascular tissues at areas where the endplate is defective.[2] MC type I (hypointense on T1-weighted imaging and hyperintense signal in T2-weighted imaging) correspond to vertebral body edema. In type II (hyperintense signal in T1-weighted imaging and hyperintense signal in T2-weighted imaging) there is a fatty replacement of the red bone marrow while in type III MC (hypointense signal in T1-weighted imaging and hypointense signal in T2-weighted imaging) reflects subchondral bone sclerosis which could be detected histologically.[7,11,17,21] These changes are usually associated with back pain that may be refractory to nonsurgical treatment and exercise.[8,9,20]

Clinically, herniation of the lumbar intervertebral disc is considered the most common cause of persistent back pain. However, changes in the intervertebral endplates (MC) can also be incriminated in the production of such pain due to the mechanical failure and structural changes that can be detected in the region of the highly pain sensitive intervertebral endplates.[2,11,13,16] Moreover, continued post lumbar discectomy back pain is usually attributed to the presumed hypermobility of the affected segment but the effect of the stressed degenerated endplates has been erroneously overlooked.[2] Therefor, there is still a controversy regarding the surgical treatment of the predominantly axial pain secondary to degenerative lumbar disc disease. Especially in patients with MC type I, a microdiscectomy without fusion can still offer a significant improvement in their back pain.[17] Furthermore, apart from patients who have established spinal instability and are well known to get benefit from fusion, indications for such fusion surgeries lack a clear supportive evidence.[3,8]

In this study, the authors evaluate the effect of adding fusion to simple discectomy in treatment of patients of lumbar disc herniation that show evidence of MC on preoperative MR images regarding the control of postoperative low back pain and functional outcome.

PATIENTS AND METHODS

This is a retrospective cohort study of 44 patients who underwent surgical management of low back pain and sciatica due to lumbar intervertebral disc herniation with concomitant presence of Modic changes in the preoperative MR images at the authors' institution between January 2013 and December 2016. Patients' Data were retrieved from the department of neurosurgery registry.

The data set included patients' demographic data, complaints at time of surgery, preoperative visual analogue scale (VAS) of low back pain and Oswestry Disability Index[6] (ODI) scores of the functional disability and comorbidities. Preoperative radiographs including dynamic

x-rays and MR images were also reviewed for detection and documentation of Modic change type. Moreover, the modality of surgical intervention was used to classify patients into two groups: Group A (Discectomy group), and Group B (Fusion group). Nineteen patients (43.2%) were allocated randomly in Group A and 25 patients (56.8 %) in Group B. Patients included in this cohort had single level lumbar disc herniation with Modic changes (Figures 1,2,3). On the other hand, patients with preoperative radiographic evidence of instability and patients whose 1-year post-operative data were incomplete were excluded. Data from patients' visits to the outpatient clinic were collected with special attention to the 1-year post-operative VAS for low back pain and ODI scores, plain postoperative radiographs, and any surgery related complications. It is to be noted that all patients included in the fusion group had neither an evidence of fusion failure in postoperative X-rays nor hardware related complications.

Collected data were expressed as mean±SD and range, and compared via the suitable statistical test using SOFA statistics version 1.3.3 software.

RESULTS

The current study included 44 patients (25 males and 19 females) with a mean age of 43.48±10.92 years ranging from 28 to 63 years allocated randomly as follow; 19 patients (43.2%) in Group A with a mean age of 41.42±11.61years (patients who underwent discectomy only) and 25 patients (56.8 %) in Group B with a mean age of 45.04±10.32 years (patients who had fusion added to discectomy included interbody fusion in 10 patients and posterolateral intertransverse fusion in 12 patients while both modalities were utilized in 3 patients).

Out of the 44 patients included in this study, 22 patients (50%) were operated for L5-S1 herniated disc, 17 patients (38.6%) were operated for L4-L5 herniated disc, 3 patients (6.8%) were operated for L3-L4 herniated disc and one patient (2.3%) operated for each of L2-L3 and L1-L2 levels disc herniation. Additionally, type I MC were reported in 24 patients (54.5%) while type II MC were reported in 12 patients (27.3%) and type III MC in 8 patients (18.2%). Demographic, clinical and radiologic data for patients in both groups are illustrated in table 1.

Low back pain improvement was evident and statistically significant in both groups when comparing preoperative and postoperative values of VAS using paired student-t test with p-values < 0.001 for both groups (Table 2). Moreover, both patients' groups showed a statistically significant improvement in their ODI post-operatively with P<0.001 for both groups (Table 3).

Comparison of post-operative VAS for both groups using independent student-t test revealed a statistically non-significant difference with a P=0.239 (mean VAS for Group A=2.2 while mean VAS for Group B=1.48). Additionally, the mean post-operative ODI for Group A was 70.05 and the mean post-operative ODI for Group B was 71.04 with no statistically significant difference between both patients' groups (P=0.771). Furthermore, when patients with type I MC (as a separate subgroup) in both patients' groups were compared to each other, again, a statistically significant difference could not be detected between both groups regarding post-operative VAS for low back pain with (P=0.273 and mean VAS for Group A=2.8 while mean VAS for Group B=1.7) and post-operative ODI (P=0.983 and mean VAS for Group A=70.1 while mean VAS for Group B=70.0). Additionally, when patients with type II and type III MC (as a separate subgroup) were put in comparison, no statistically significant difference could be found for both post-operative VAS for low back pain and post-operative ODI values (P=0.472 and P=0.587 respectively).

Means of estimated intraoperative blood loss, operative time and post-operative hospital stay for both patients' groups are illustrated in (Table 4). Moreover, a comparison between both groups was performed using independent student-t test and pertinent p values are also included in (Table

4). Analysis of these parameters showed that the mean estimated intraoperative blood loss was 237.105±200.88 ml in Group A and 353.6±244.93 ml in Group B. In addition, there was a statistically significant difference in the mean operative time (P<0.001) between both groups (103.9±16.96 min for Group A and 166.2±24.84 min for Group B). On the other hand, there was no statistically significant difference between both groups regarding the mean post-operative hospital stay.

Table 1. Demographic, Clinical and Radiologic Data for Patients in Both Patients' Groups.

Parameters		Group A (N=19)	Group B (N=25)
Age		41.42±11.61 (28-61) years)	45.04±10.32 (29-63) years
Gender	Male	7	18
	Female	12	7
LBP		19	25
Sciatica		19	25
Disc level	L5-S1	12	10
	L4-5	10	7
	L3-4	2	1
	L2-3	1	0
	L1-2	0	1
Modic Type	Type I	9	15
	Type II	6	6
	Type III	4	4

Table 2. Pre and Postoperative LBP Visual Analogue Score for both Patients' Groups.

Parameters		VAS	CI 95%	P value
Group A	Preoperative	8.895±0.875 (7-10)	8.501-9.288	<0.001
	Postoperative	2.211±2.440 (0.0-10.0)	1.113-3.308	
Group B	Preoperative	9.44±0.651 (8-10)	9.185-9.695	<0.001
	Postoperative	1.48±1.610	0.849-2.111	

Table 3. Pre and Postoperative Oswestry Disability Index for both Patients' Groups.

Parameters		ODI	CI 95%	P value
Group A	Preoperative	46.11±4.58 (34-51)	44.05-48.17	< 0.001
	Postoperative	70.05±12.18 (32-78)	64.57-75.53	
Group B	Preoperative	45.6±6.08 (30-52)	43.26-48.02	< 0.001
	Postoperative	71.0±10.13 (43-79)	67.07-75.01	

Table 4. Reported Perioperative Data in both Patients' Groups.

Parameters	Group A	Group B	P-value
Operative blood loss	237.105±200.88 ml	353.6±244.93 ml	0.099
Operative time	103.947±16.96 min	166.2±24.84 min	< 0.001
Hospital stay	4.11±2.31 days	4.12±1.33 days	0.979

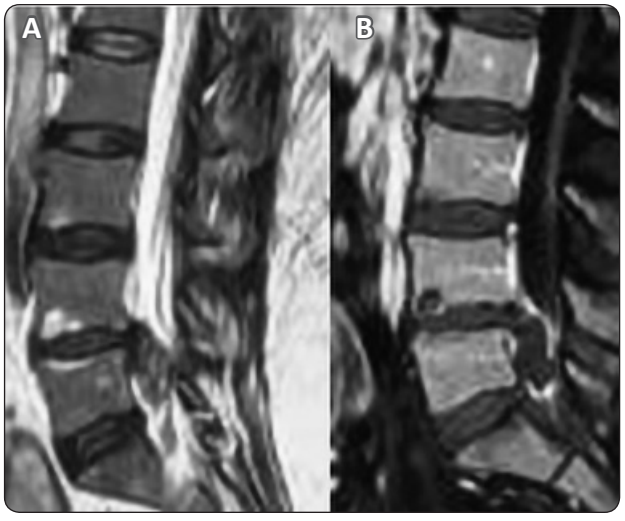

Figure 1. Sagittal MR images (T2-weighted image (left) and T1-weighted image (right)) for a patient with L4-5 disc herniation associated with type I MC. The patient underwent simple discectomy without fusion with removal of the caudally migrated disc fragment.

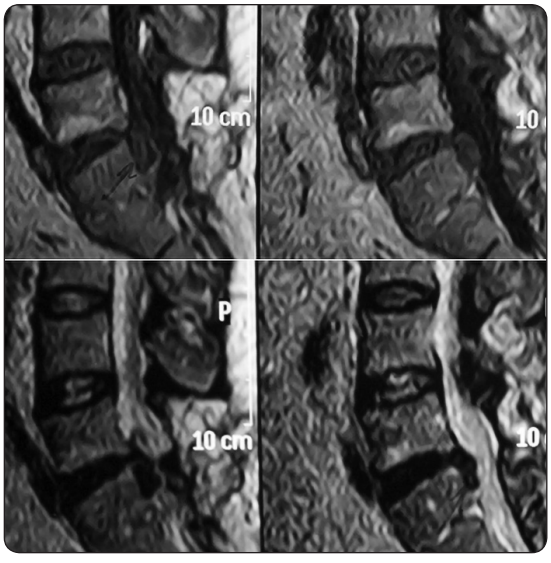

Figure 2. Sagittal MR images (T1-weighted image (upper row) and T2-weighted image (lower row)) for a patient with L4-5 disc herniation associated with type II MC. The patient underwent simple discectomy without fusion with removal of the caudally migrated disc fragment.

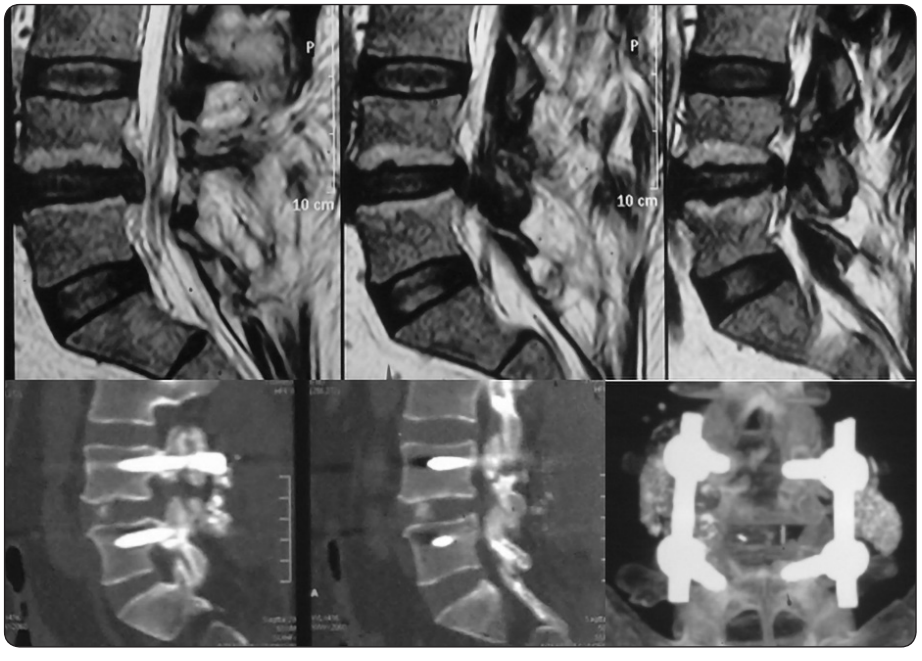

Figure 3. Preoperative T2-weighted sagittal MR images (upper row) and postoperative reconstructed computerized tomography images (lower row) for a patient with L4-5 disc herniation associated with type II MC. The patient underwent discectomy with both intertransverse and interbody fusion with removal of the caudally migrated disc fragment.

DISCUSSION

Being an intervening structure between the resilient intervertebral disc and the stiff vertebral body, the vertebral end-plate has been proven to be of utmost importance for a normally functioning spine and its failure is associated with symptomatic degenerative spinal pathologies.[13,16] Moreover, a strong relationship between MC and discogenic back pain could be observed.[4,10,21] However, the effect of MC on clinical outcome of different treatment modalities has still been controvertial.[11,21] In the current study, the authors

evaluated the effect of adding spinal fusion to simple lumbar discectomy in patients of disc herniation associated with MC on clinical and functional outcome.

Regarding patients' demographic data, the mean age of patients in the current study was 43.48 years and patients showed male predominance (56.8 % of patients). These results were matching reports of similar studies.[1,2,3,15,19] More than 88% of patients included in the current study were operated upon for pathologies affecting L 4-5 and L5-S1 levels (38.6% for L4-5 level and 50% for L5-S1 level) and this was similar to other reports.[1,19,20,21]

In the current study, both patients' groups (the discectomy and fusion groups) showed statistically significant clinical and functional improvements in terms of changes in the mean pre-operative and post-operative VAS for low back pain and ODI values. However, comparison between both groups failed to reveal that any of them was significantly superior to the other regarding the forementioned parameters. Moreover, comparison between different subgroups according to the MC type again failed to reveal any statistically significant difference in outcome between both patients' groups (the discectomy and fusion groups). Hence, in terms of low back pain control and functional outcome, simple discectomy was found to be compatible to spinal fusion in patients who have evident MC on their pre-operative MR images. This finding was consistent with the conclusion of Djurasovic et al,[3] who stated that Modic vertebral endplate changes were not among the factors that can predict post-operative improvement after fusion and were erroneously used to justify fusion procedures. In addition, Zhang et al,[21] could not recommend stabilization or fusion procedure as a standard treatment modality for patients with symptomatic type I MC and they recommended further investigation for this issue. Similarly, Jensen et al,[8] recommended further research to define the influence of the presence of MC on decision making regarding control of low back pain. Moreover, Sørlie et al,[17] reported a significant improvement of low back pain after 1 year in patients with type I MC after microdiscectomy unless they were cigarettes smokers. Eser et al,[5] and Ghodsi et al,[7] recommended spinal fusion for patients with MC only when instability coexists.

On the other hand, Kwon et al,[12] recommended posterior fusion for patients having type I and type II MC as a reasonable surgical option. However, Vital et al,[18] recommended posterior fusion only for patients with type I MC (excluding benefits for type II) and they stated that such fusion can promote and accelerate healing of the inflammatory process the takes place in the vertebral end-plates.

After the preceding argument, factors other than low back pain control and functional outcome should be sought for to aid in evaluation of the efficiency of spinal fusion in these patients. In the current study, there was a statistically significant difference in the mean operative time in favor of the discectomy group (Group A). Furthermore, the mean estimated intraoperative blood loss was lower in Group A when compared to Group B with a weak but evident statistical significance (237.105±200.88 ml and 353.6±244.93 ml respectively with a P=0.099) These findings, together with the financial burden of the hardware used for instrumentation, can be used as a reasonable evidence that simple lumbar discectomy without fusion is still a viable surgical option in treatment of patients with lumbar disc herniation with MC.

CONCLUSION

Unless otherwise indicated, simple lumbar discectomy without fusion is a reasonable surgical option in treatment of patients with lumbar intervertebral disc herniation even in the presence of Modic changes in their pre-operative MRI.

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الملخص العربى

تأثير تثبيت الفقرات المضاف إلى استئصال الغضروف القطني في المرضى الذين يعانون من تغيرات مودك: تحليل نتائج مقارنة بأثر رجعي فيما يتعلق بألم الظهر

البيانات الخلفية: تم استخدام تغيرات موديك بشكل موثوق للإشارة إلى التغيرات فى الرنين المغناطيسى التي يمكن اكتشافها في النهاية الفقارية والجزء المجاور للغضروف من الجسم الفقري ويمكن أن تُعزى بقوة إلى اعتلال الغضروف الفقري. هذه التغيرات هي انعكاس للتغيرات الالتهابية التي تحدث بالقرب من الغضروف ويمكن أن تعزى إلى ترسيب الأنسجة الليفية الوعائية في المناطق التي تكون فيها الغضاريف معيبة. سريريا ، يعتبر انزلاق الغضروف الفقري القطني السبب الأكثر شيوعا لآلام الظهر المستمرة. ومع ذلك ، يمكن أيضا أن يكمن السبب فى تغييرات موديك احداث مثل هذا الألم بسبب الفشل الميكانيكي والتغيرات الهيكلية التي يمكن اكتشافها أكثر في تلك المنطقة ذات الحساسية الشديدة للألم. علاوة على ذلك ، عادة ما يُعزى استمرار آلام الظهر بعد استئصال الغضروف القطني إلى فرط الحركة المفترض للجزء المصاب ، ولكن تأثير تغييرات موديك قد تم تجاهله بشكل خاطئ.و على ذلك لا يزال هناك جدل بشأن المعالجة الجراحية لالام اسفل الظهر الناتجه عن انزلاق الغضروف الفقري القطني.

تصميم الدراسه: دراسه مرجعيه مقارنه.

الغرض: هذه الدراسة هي محاولة الباحثين لمعرفة ما إذا كان هناك أي لتثبيت الفقرات فيما يتعلق بتحسن الام اسفل الظهرومعدل العجز بمقياس اوسوستري فى حالات الانزلاق الغضروف القطني المصحوب بتغييرات مودك في صور الرنين المغناطيسى قبل الجراحة.

المرضى و الطرق: يعتبر هذا البحث دراسه مرجعيه مقارنه على 54 مريضا خضعوا لجراحة لعلاج آلام أسفل الظهر و / أو عرق النسا بسبب انزلاق غضروف فقري قطني مع ما يصاحب ذلك من وجود تغييرات مودك في صور الرنين المغناطيسى قبل الجراحة في فى الفتره بين يناير 2013 وديسمبر 2016. المرضى تم استرجاع بياناتهم من قسم قاعدة بيانات قسم جراحة المخ والأعصاب. تضمنت مجموعة البيانات الديموغرافية للمرضى ، والشكاوى في وقت الجراحة ، والأمراض المصاحبة ومعدل العجز بمقياس اوسوستري قبل الجراحة لألم أسفل الظهر. كما تم مراجعة صور الاشعات قبل الجراحة بما في ذلك الأشعة السينية الديناميكية وصور الرنين المغناطيسى للكشف وتوثيق نوع تغيرات موديك. وعلاوة على ذلك ، تم استخدام طريقة التدخل الجراحي لتصنيف المرضى إلى مجموعتين: المجموعة A (مجموعة استئصال الغضروف) ، والمجموعة B (مجموعة التثبيت). تم جمع البيانات من زيارات المرضى للعيادة الخارجية مع إيلاء اهتمام خاص إلى درجة ومعدل العجز بمقياس اوسوستري بعد عام من العمليات الجراحية لآلام أسفل الظهر. المرضى المشمولين في هذه المجموعة كانوا يعانون من انزلاق غضروف فقري قطني لمستوى واحد فقط ، وعلى الجانب الآخر ، تم استبعاد المرضى الذين لديهم دليل من الاشعات على أي درجة من عدم الاستقرار الفقارى.

النتائج: تم اثبات وجود تحسن واضح احصائيا فى كلتا مجموعتى البحث فيما يخص الام اسفل الظهرومعدل العجز بمقياس اوسوستري مع عدم وجود فارق واضح احصائيا بين المجموعتين.

الاستنتاج: ما لم يذكر خلاف ذلك ، استئصال الانزلاق الغضروفى القطني البسيط بدون التثبيت هو خيار جراحي معقول في علاج المرضى الذين يعانون من الانزلاق الغضروف القطني المصحوب بتغييرات مودك في صور الرنين المغناطيسى قبل الجراحة.