

Failed Back Surgery Syndrome: Magnetic Resonance Imaging Assessment

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Abstract

Background data: Failed back surgery syndrome (FBSS) refers to pain and functional incapacitation of varying degrees following spinal surgery for low back pain. FBSS represent almost 10-40% of patients. MRI is the best diagnostic modality for detection of its causes, after full clinical assessment.

Study Design: this is a prospective clinical case study

Purpose: The aim of this study is to describe the various MRI findings seen in the postoperative spine of patient with failed back surgery syndrome.

Patients and methods: this study carried out forty patients complaining of recurrent back-pain and/ or sciatica after back surgery. All patients were referred from orthopedic department to radiology department of Zagazig University hospitals for MRI examination, after full clinical assessment. Patients were evaluated clinically and examined by magnetic resonance imaging. This study was conducted through July 2012 to March 2014. Patients were 28 males & 12 females with a mean age of 41.6 (20-78 years) age. All patients were managed according to their clinical picture and MRI findings.

Results: Eighteen patients (45%) showed recurrent disc prolapse; 10 (25%) patients postoperative epidural fibrosis; 6 (15%) both recurrent disc prolapse and epidural scarring; two (5%) patients arachnoiditis, two (5%) patient discitis, one (2.5%) patient postoperative pseudomeningocele formation & one (2.5%) patient postoperative epidural hematoma collection. Gadolinium-diethylenetriaminepenta-acetic acid (Gd-DTPA)-enhanced MRI was particularly helpful in differentiating recurrent disc prolapse and epidural fibrosis.

Conclusion: MRI correctly predict recurrent disc prolapse, epidural fibrosis, arachnoiditis, spinal stenosis and other causes of failed back surgery syndrome, illustrating the value of this modality in the evaluation of FBSS. (2014ESJ068)

Key Words: epidural fibrosis, recurrent disc prolapse, arachnoiditis, MRI, spinal stenosis.

Introduction

Failed back surgery syndrome (FBSS) refers to pain and functional incapacitation of varying degrees following spinal surgery for low back pain. The reported frequency is 10%-40%.²⁰ There are many causes of FBSS and they include recurrent disc prolapse, postoperative epidural fibrosis, spinal stenosis, pseudomeningocele formation, arachnoiditis, mechanical instability after laminectomy, nerve injury and even wrong level surgery. The two commonest causes by far are recurrent disc prolapse and epidural fibrosis or a combination of both. Gd-DTPA enhanced MRI is particularly valuable in differentiating recurrent disc prolapse and post-operative scar tissue.^{1,2,7,11} Epidural fibrosis encroaching upon the thecal sac is the most common cause of failed back surgery. The second common cause of failed back surgery is recurrent disc herniation. Lastly, lateral recess stenosis caused by post-operative adhesion and facet arthropathy.¹⁵

MRI findings of failed back surgery have a role in differentiation of causes of failed back surgery syndrome. Scar tissue typically appears as slightly increased in signal intensity relative to disc herniation in the area of laminectomy on T2-weighted images with homogenous post contrast enhancement.^{3,13,16} Scar tissue enhancement may be seen in patients whose surgery has taken place more than 20 year ago. The peak enhancement of scar tissue is 5-6 minutes after contrast injection. Hence, early scanning for accurate diagnosis is mandatory especially when disc is known to enhance in delayed scans. Although scar is generally believed to demonstrate retraction, a space occupying effect is often noted.^{6,7,9}

Recurrent disc herniation appears as soft tissue mass which appears to be in continuity with the parent disc with low to isointense signal intensity and isointense signal with sometimes hyperintense zone without post-contrast enhancement⁽¹⁶⁾. Other associated MRI findings of cases of failed back surgery were arachnoiditis which appear as indistinct cord due to increased cerebral spinal fluid (CSF) intensity on T1WI, clumped nerve roots forming cords or nerve roots adhering to walls of the thecal sac "Empty thecal sac sign" on T2WI with minimal to mild cord, nerve root, and dural post contrast enhancement. Epidural abscess which

appear as iso- to hypointense signal compared to cord signal intensity on T1WI, hyperintense on T2WI and had heterogeneously post-contrast enhancing phlegmon & ring post contrast enhancement.^{10,14}

Patients and Methods

Forty consecutive patients with previous lumbar spine surgery were included in this prospective study (table 1). There were 28 (70%) males and 12 (30%) females. The average age of male patients was 39.7 years (range 20-52 years) and females 43.9 years (range 20-78 years). The average age of all patients was 41.6 years. All patients were examined clinically and clinical data are summarized in (table 2) and meanwhile by MRI.

MRI examination was performed on a 1.5 tesla superconducting MR imager (Philips-Achieva). The patients were examined with the following protocol initially:

a) sagittal spin echo (SE) T1-weighted (500/15; repetition time [TR] msec/echo time [TE]), sagittal SE T2-weighted (TRITE 2200/S0) and b) axial SE T1-weighted (TRITE 500/15). After the injection of contrast (Magnevist 0.1 mmol/kg body weight) axial images were obtained (TRITE 500/15). The imaging matrix was 256 x 256 with a slice thickness of 4mm and a 10% interslice gap (0.4 mm). The T1-weighted images were performed with three excitations while the T2-weighted scans used only one excitation. The post-contrast scans were performed with minimal delay following injection of contrast to avoid possible confusion arising from delayed contrast enhancement in prolapsed discs.

Results

The results of this study are summarized in table 3. Eighteen patients (45%) showed recurrent disc prolapse. A diagnosis of recurrent disc is based on the presence of a soft tissue mass which appears to be in contiguity with the parent disc. When large enough space, a occupying effect may be seen. It should show no contrast enhancement and of low signal intensity in the T2-weighted sequence. In the axial T1-weighted image, the lesion is isointense with disc. In the post-contrast examination, no contrast enhancement is evident indicating the presence of a recurrent central disc prolapse (Figure 1).

Ten patients (25%) had postoperative epidural fibrosis. A diagnosis of epidural scar is made in the presence of a soft tissue mass with contrast

enhancement. Epidural fibrosis may or may not be associated with space occupying effect. It should also be of low signal intensity in the T2-weighted sequence. In addition, the nerve root appears obscured. Following the injection of contrast, there was good contrast enhancement proving the presence of scar tissue encasing the nerve root. Six patients (15%) had both recurrent disc prolapse and epidural scarring. These patients show both enhancing and non-enhancing intraspinal soft tissue lesions. This diagnosis is made in the presence of a non-enhancing soft tissue mass surrounded by an enhancing lesion. There is effacement of the epidural fat and the spinal canal appears narrowed. After the administration of contrast, there was no enhancement in the central portion while the rest of the lesion demonstrated an increase in signal intensity. These findings are typically seen in recurrent disc prolapse with associated fibrosis. (Figure 2)

Two patients (5%) demonstrated features of

Table 1. Initial Surgical Procedure in this Study (N=40).

Procedure	No.
Single level unilateral laminotomy	17 cases (42.5%)
Single level bilateral laminectomy	8 cases (20%)
Two level laminotomy	10 cases (25%)
Decompression and posterolateral fusion	3 cases (7.5%)
Transforaminal lumbar interbody fusion	2 cases (5%)

postoperative arachnoiditis with clumping of the nerve roots centrally within the thecal sac. Two (5%) patient had a postoperative discitis. One (2.5%) patient had a post-operative pseudo-meningocele & one (2.5%) patient had left epidural abscess. In the axial T1-weighted scan a low signal intensity lesion posterior to the thecal sac with no contrast enhancement was noted. The high signal on the T2W sequence with no enhancement in the T1W sequence after Gd-DTPA injection indicate the presence of a cystic structure such as a cerebrospinal fluid (CSF) collection (Figure 3).

Thirty four patients were re-operated. Surgery confirmed the preoperative diagnosis of recurrent disc prolapse in 18 patients, epidural fibrosis in 8 patient, both disc prolapse and epidural fibrosis in 6 patients, epidural hematoma collection after wide compression and posterolateral fusion in one patient, and pseudo-meningocele in one patient. No false positive or false negative cases were encountered in this series of patients.

Table 2. Demographic Data of Patients in this Study (N=40).

Parameters		No.
Age	46.7 (20-78)	
Sex	Male	28 (70%)
	Female	12 (30%)
Sciatica	Right	9 (22.5%)
	Left	14 (35%)
	Bilateral	8 (20%)
Duration	22.9/mos	
Back pain	Number	9 (22.5%)
	Duration	9/mos
Back trauma	6 (15%)	

Table 3. Causes of FBSS in our Patients (N=40).

FBSS Cause	No.	%
recurrent disc prolapse	18	45
postoperative epidural fibrosis	10	25
Epidural fibrosis & recurrent disc Arachnoiditis	6	15
	2	5
Discitis	2	5
postoperative pseudomeningocele	1	2.5
postoperative epidural hematoma collection	1	2.5

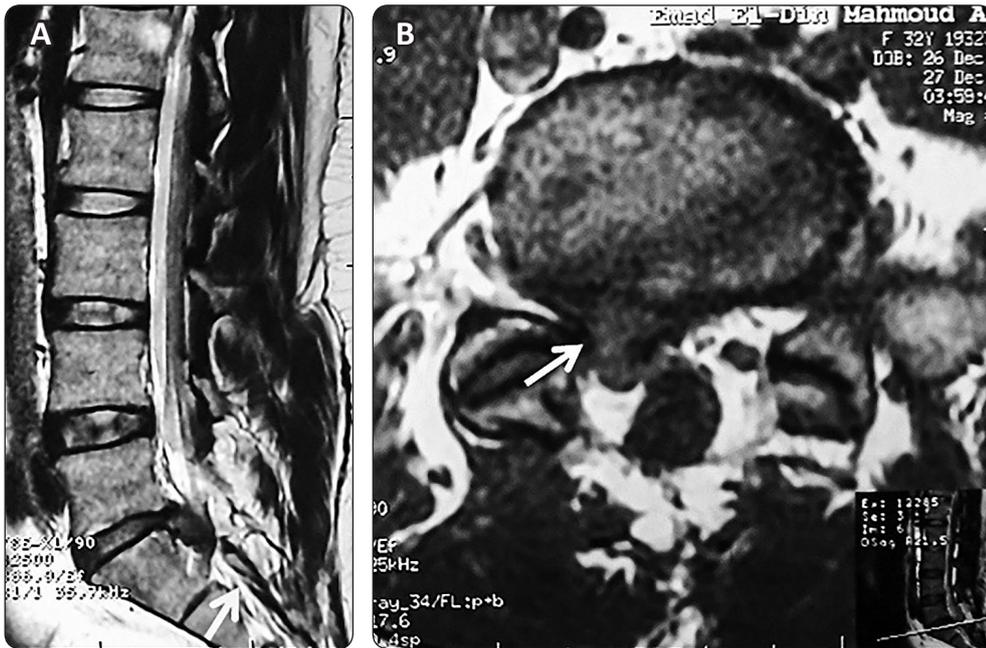


Figure 1. (A) Sagittal and (B) axial T2W MRI shows post-operative L5-S1 Rt. sided posterolateral disc sequestration.

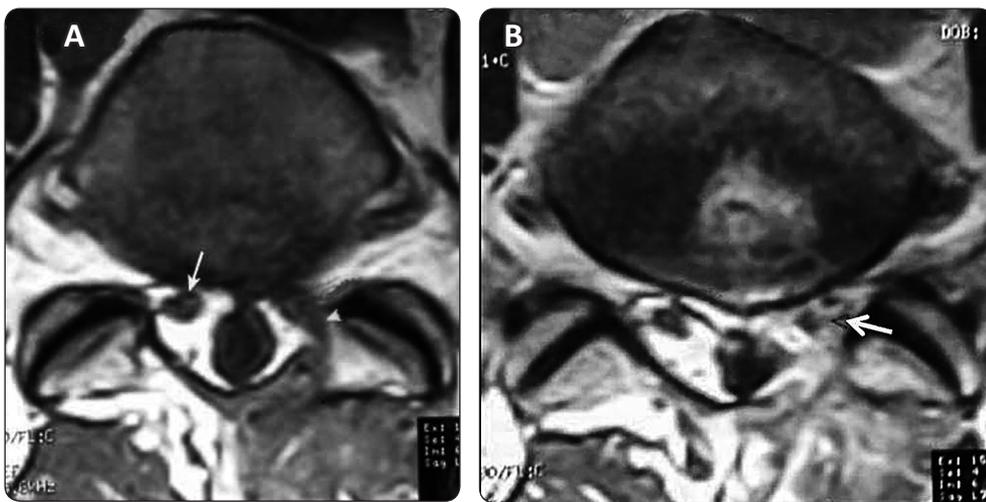


Figure 2. (A) Axial T1W MRI and (B) axial T1W post-contrast MRI show a left sided post-operative fibrosis.

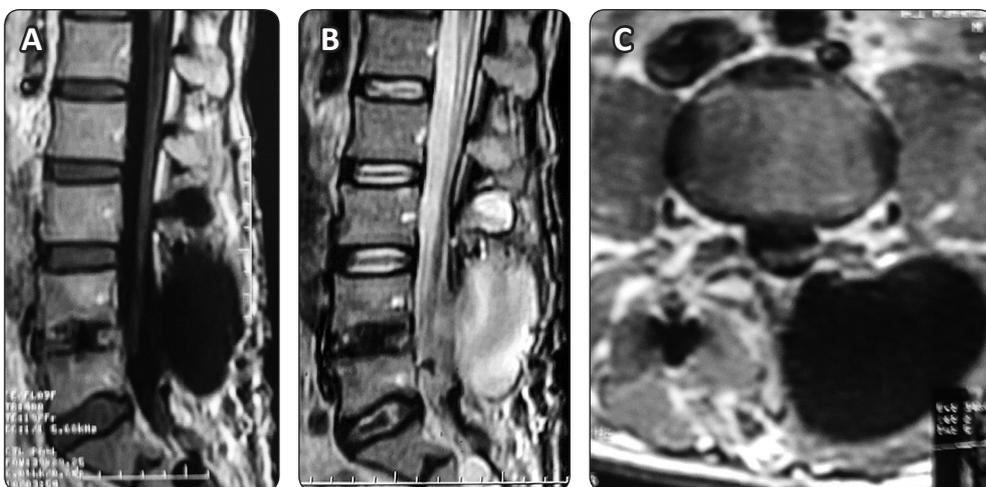


Figure 3. (A) sagittal T1W, (B) T2 W & (C) axial T1W post-contrast MRI show a post-operative pseudomeningocele at L4-5 level.

Discussion

The failed back surgery syndrome is a common clinical disorder. The recurrence of backache or the failure of pain relief after surgery is distressing to both the patient and the surgeon concerned.^{6,9} Metehan and Hidayet¹⁴ defined failed back surgery syndrome as the condition that back surgery fails to meet expectations, objectives and aims of a patient before the operation. The major identifiable causes of FBSS include recurrent or residual disc herniation, postoperative epidural fibrosis, arachnoiditis, radiculitis, and failure to correctly identify the structural source(s) of pain.¹³ The failed back surgery syndrome (FBSS) is a difficult diagnostic problem both clinically and radiologically.

In our study we found that recurrent disc prolapse is the most common cause for failed surgery in 18 cases (45%) followed by epidural fibrosis in 10 cases (25%), recurrent disc and epidural fibrosis in 6 (15%) patients and two (5%) patients with discitis and this agree with Jeffrey et al,¹⁰ whom analyzed 43 patients that were operated because of FBSS, fifteen (33%) patients had recurrent disc prolapse, another fifteen (33%) patients had postoperative epidural fibrosis, eight patients with both recurrent disc prolapse and epidural fibrosis, four patients (9%) were noted to have spinal stenosis, two of them had epidural fibrosis and recurrent disc prolapse and one (2%) patient had an epidural cystic lesion, and agree also with Metehan and Hidayet¹⁴ whom analyzed seventy cases were operated because of FBSS. The forty-five (64%) had recurrent disc herniation, nine (12.8%) had epidural fibrosis and recurrent disc herniation, eight (11.4%) had paraspinal abscess, one (1.4%) had postoperative discitis, three (4.2%) lumbar stenosis, three (4.2%) had neural foramina stenosis, one (1.4%) postoperative discitis, one (1.4%) had cerebral spinal fluid (CSF) fistula.

In our study the MRI sequences and findings agree with most of the previous reports¹⁴⁻¹⁷ as a common and constant finding. As we found that MRI is the gold standard imaging for the evaluation of patients with recurrent clinical symptoms after surgery because of its superiority in evaluating soft tissue, recurrent disc herniation appear as low to isointense signal intensity on T1WI, displaced disc material with reduced disc height, isointense signal with sometimes hyperintense zone on T2WI without

post-gadolinium enhancement. Scar tissue appears as low signal intensity in the area of laminectomy, high signal intensity in the area of laminectomy with post-gadolinium homogenous enhancement.

Not all scar tissue is secondary to surgery. It is known that a prolapsed disc may incite fibrosis in the absence of surgery. Hence, the scarring noted in conjunction with recurrent disc prolapse may be a response to the presence of disc material rather than the result of surgical trauma.^{18,20} Arachnoiditis may cause persistent pain following surgery in 6%-16% of patients.¹¹ Arachnoiditis, appearing as indistinct cord on T1WI due to increased cerebral spinal fluid (CSF) intensity, clumped nerve roots forming cords or nerve roots adhering to walls of thecal sac on T2WI with minimal to mild cord, nerve root, and dural enhancement. Epidural abscess seen as iso to hypointense signal to cord on T1WI, hyperintense signal on T2WI and post-gadolinium heterogeneous enhancement phlegmon with peripherally enhancing ring. Paravertebral abscess seen as a lesion with central low signal intensity and isointense signal in the margin on T1WI, with central high signal intensity and high signal intensity in the margin on T2WI with post-gadolinium ring enhancement.^{1,2}

Conclusion

Gd-DTPA enhanced MRI is an extremely useful method of studying failed back surgery syndrome. It can accurately diagnose recurrent disc prolapse, epidural fibrosis or a combination of both by their characteristic contrast enhancement pattern. It is now the modality of choice in the evaluation of the postoperative spine.

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تقييم حالات فشل جراحات الظهر باستخدام الفحص بالرنين المغناطيسي

خلفية البيانات: تشير متلازمة فشل ما بعد جراحة الظهر إلى الألم والعجز الوظيفي بدرجات متفاوتة بعد جراحة العمود الفقري لآلام أسفل الظهر. تمثل هذه المتلازمة ما يقرب من ١٠-٤٠٪ من المرضى. التصوير بالرنين المغناطيسي هو أفضل طريقة تشخيصية للكشف عن أسبابه، وبعد التقييم السريري الكامل.

الغرض: تشخيص حالات فشل جراحة الظهر باستخدام الرنين المغناطيسي.

الطرق والمرضى: أجريت هذه الدراسة على أربعين مريضاً يعانون من آلام بالظهر أو الساق بعد إجراء جراحة لعضروف الظهر، بمستشفيات جامعة الزقازيق في الفترة من يوليو ٢٠٢٢ إلى مارس ٢٠١٤، وكان المرضى ٢٨ ذكور و ١٢ إناث، تراوحت أعمارهم من ٢٠ إلى ٧٨ سنة بمتوسط ٤١ سنة. وقد تم تقييم الحالات أكلينيكيًا على أنها حالات فشل جراحة الظهر، كما تم فحص جميع الحالات بالرنين المغناطيسي بعد فحصهم وتقييمهم جميعاً أكلينيكيًا، وتم معالجة المرضى كل حسب ما أظهره فحص الرنين المغناطيسي وشكوى كل مريض وتقييم حالته أكلينيكيًا.

النتائج: وجد في هذا البحث أن ثمانية عشر مريضاً يعانون من انزلاق غضروفي مرتجع بعد الجراحة، وعشرة مرضى يعانون من التصاقات ليفية، وستة مرضى يعانون من انزلاق غضروفي مرتجع والتصاقات ليفية، ومريضان يعانون من التهاب غشاء الأراكنويد، ومريضان يعانون من التهابات غضروفية، ومريض يعاني من كيس سحائي كاذب، ومريض واحد يعاني من تجمع دموي ملتهب فوق الأم الجافية للحبل الشوكي. وجد من البحث أن الرنين المغناطيسي بعد حقن الصبغة مفيد في التفرقة بين العضروف المرتجع والتصاقات الليفية بعد الجراحة.

الخلاصة: الرنين المغناطيسي له دور فعال ودقيق في اكتشاف حالات العضروف المرتجع بعد جراحة الظهر وكذلك في التفرقة بينها وبين التصاقات الليفية باستخدام الوسط المتباين (الصبغة)، كما أنه يكتشف أي مضاعفات تحدث للمريض بعد الجراحة كالتصاقات الغضروفية والتجمع الدموي أو الصديدي وكذلك ضيق القناة الفقرية العصبية.