

Correlation of the Severity of Lumbar Disc Degeneration, Using a Validated Classification, with Provocative Discography

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ABSTRACT

Background: Over several decades, investigators have been trying to identify the painful degenerate disc. Their work included two main methods. The first was to set criteria on the radiological investigations, mainly the MRI scan, to describe the severity of the degenerative disc disease (DDD); and the second was to perform discographies. Neither of these two methods precluded the need for the other. **Purpose:** Using Pfirrmann's classification, we correlated the static MRI images, for the severity of disc degeneration, with the dynamic lumbar discography, aiming at improving the identification of painful 'discogenic' intervertebral segments. **Study Design:** Prospective cohort study. **Patient Sample and Method:** 69 patients (45 females, 24 males). The average age was 38.9 years (range 20-56). All patients had DDD on lumbar MRI scans. The severity of DDD was graded using Pfirrmann's classification. A total of 162 discographies were performed using "miss the facet joint, double needle technique". **Outcome Measures:** During discography typical or concordant pain only was regarded as positive. Among each of the five Pfirrmann grades, the percentage of positive discographies was calculated. Significance and correlation were then investigated using the Chi-squared and Spearman's correlation tests. **Results:** The percentages of positive provocative discography for concordant pain among the five Pfirrmann's grade were 0%, 9.1%, 71.4%, 100% and 100% respectively. Statistical analysis showed a high correlation between the severity of DDD on MRI scan and the result of the provocative discography. **Conclusion:** The higher the grade of segmental DDD, the more likely it will be painful on discography. All discs showing Pfirrmann grade IV and V disease were painful on discography.

INTRODUCTION

Low backache is an extremely common complaint. Most of low back complaints are minor and self-limiting and even if severe, can still respond well to various simple measures including medications and rest. However, in the last 50 years the number of people complaining of significant low back pain leading to serious persistent disability has increased significantly in the industrial world leading to a major health problem^(1,2). Among those with severe persistent back pain, a clear organic cause was not always identified. On the contrary, a number of non-organic reasons have been identified in some of these patients including poor job satisfaction, emotional troubles and

workers compensation or personal injury claims⁽³⁻⁷⁾.

The mere presence of disc degeneration or herniation does not necessarily mean that it is symptomatic⁽⁸⁻¹¹⁾. Magnetic resonance imaging (MRI) has been found to demonstrate degeneration or bulging of a disc at least at one lumbar level in 35 percent of the subjects between twenty and thirty-nine years old and in all but one of the sixty to eighty years old subjects⁽⁸⁾. Disc herniations have been reported to occur in 28 percent of asymptomatic volunteers⁽⁹⁾. This observation was demonstrated even more strongly in a study by Boos et al., when they analyzed MRI findings in a population that was age, gender and risk factor matched to a population with low back pain and sciatica. They

reported that 76 percent of the asymptomatic group had a disc herniation at least at one level⁽¹⁰⁾. Moreover, MRI failed to predict the development of back pain in initially asymptomatic subjects when they were reviewed 10 years after detecting disc abnormalities⁽¹¹⁾.

The presence of disc abnormalities on MRI in asymptomatic subjects raised a question about their link to back pain in symptomatic subjects. The picture can be further complicated by the non-organic factors mentioned above. Accordingly, a dynamic investigation was needed to directly relate the static radiographic image to the patient's pain. Discography is the only method to do that. Discography is performed by injection of a radiographic contrast into the nucleus of an intervertebral disc. During the injection, the investigator performing the procedure asks the patient whether or not the pain generated is similar to his/ her pain. As a control and to help prediction of non-organic factors, the normal adjacent disc is also injected. Instead of provoking pain, an anesthetic substance can be injected and the pain relief evaluated. This is called anesthetic discography.

Discography does not only evaluate pain but also shows the internal disc morphology and helps to identify the degree of degeneration and annular tears seen in the static post injection images^(12,13). Based on cadaveric lumbar spine discographies, Adams et. al. in 1986⁽¹⁴⁾, described 5 morphological grades for disc degeneration (fig. 1).

When pain evaluation is concerned, the problem with discography is that its result is subjective. Studies have shown that significant pain can also be produced by injecting normal discs. It was also found that abnormal contrast patterns were found in high numbers in

asymptomatic subjects. The incidence of false positive discographies was reported to be as high as 30–40%^(15,16). In addition to that, the safety of discography was questioned in a number of early studies after reports of inadvertent intradural injections leading to headache, meningitis, arachnoiditis, intradural hemorrhage and reaction to the dye. Discitis was also reported⁽¹⁷⁻²¹⁾. That is why discography was criticized based on whether the information gained from such an invasive investigation justifies the associated risks⁽²²⁾. On the other hand, several studies supported the use of discography as a valuable diagnostic tool with low complication rate⁽²³⁻²⁹⁾.

In 2001, Pfirrmann et al. described a new MRI classification for lumbar degenerative disc disease (DDD), based on the disc appearance on T2-weighted mid-sagittal images. Five grades have been described (fig. 2). Grade I; bright white homogeneous, grade II; white inhomogeneous with possible horizontal bands, grade III; inhomogeneous grey with unclear distinction between annulus and nucleus, grade IV; inhomogeneous grey or black with lost distinction and grade V; as grade IV plus collapsed disc space⁽³⁰⁾. This is the classification used in the current study.

In view of the great controversy about the diagnostic value of discography and its safety and taking into consideration that MRI alone can never locate painful discs; we got the idea of measuring the number of positive provocative lumbar discographies among each of Pfirrmann grades, hoping for better identification of the “truly” painful discs and if possible, stopping or at least minimizing the use of discography in the advanced grades of degeneration.






Morphological grade (Pathology: normal/abnormal)		Degree of disc degeneration as seen on discography
1. Cottonball (NORMAL)		Regular and smooth, uniformly appearing discogram
2. Lobular (NORMAL)		Slightly irregular, bilobed "hamburger" appearance representing early degeneration
3. Fissuring (ABNORMAL)		Degenerate but contained disc usually with posterior and radial annular tear or fissuring
4. Multiple fissuring (ABNORMAL)		More advanced but contained degenerate disc with multiple fissuring throughout
5. Ruptured with leakage (ABNORMAL)		Advanced and grossly degenerate ruptured disc with contrast extravasation throughout

Fig. (1): Five morphological grades for lumbar disc degeneration as seen on discography⁽¹⁴⁾.

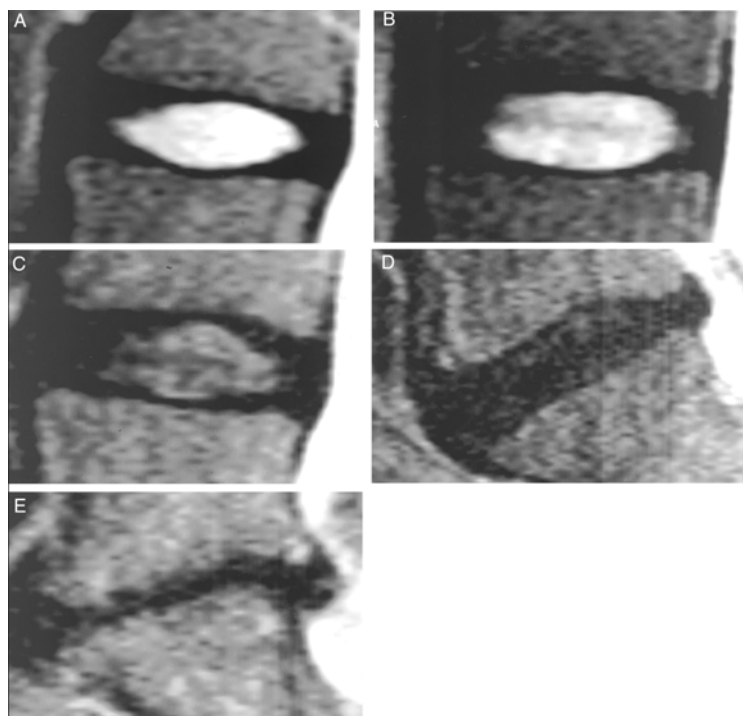


Fig.(2): Pfirrmann's MRI grades for disc degeneration. Images A-E coincide with grades I-V respectively⁽³⁰⁾.

PATIENT & METHOD

A prospective cohort study was conducted. Inclusion criteria included patients with significant mechanical low back pain and disability (Oswestry Disability Index >40 and Visual Pain Analogue Score > 4/10) who exhausted the conservative measures for more than 6 months, have no litigations and MRI showed single or double level degenerate discs.

69 patients have been investigated (45 females, 24 males). The average age was 38.9 years (range 20-56). Provocative discographies were performed in all cases as a routine investigation to identify painful levels prior to fusion or disc replacement surgery. The severity of DDD was graded using Pfirrmann's classification. The mid-sagittal T2 weighted images were evaluated (TR 3500 - 4500, TE 90 - 100, 4 mm thick fast spin-echo). A total of 162 discographies were performed using "miss the facet joint, double needle technique".

During discography typical or concordant pain only was regarded as positive. Among each of the five Pfirrmann grades, the percentage of positive discographies was calculated. Significance and correlation were then investigated using the Chi-squared and Spearman's correlation tests.

Discography technique:

All discographies were done by a single experienced discographer (the senior author). Standard postero-lateral approach was used. Mild neuroleptic sedation by Propofol was only used in anxious patients. Regional local

anaesthesia was always used prior to needle insertion. Under image intensifier, an oblique view of the lumbar spine was initially taken to avoid the facet joint which would provoke a lot of pain if inadvertently touched by the needle. A wider and shorter spinal needle (0.45 x 125 mm) was initially inserted down to the annulus. A small amount of local anaesthetic was injected through this needle into the pain sensitive annulus. Then, a longer and narrower needle (0.9 x 150 mm) was inserted through the wider needle and its tip placed inside the nucleus. The position of the needles was verified in the AP and lateral views then Iohexol non-ionic contrast (Omnipaque) was injected. The procedure was also done in the normal adjacent disc level as a control (fig.3). This is called "miss the facet joint, double needle technique" and it was used in this study to gain the patients' confidence, try to alleviate any apprehension or fear and avoid any pain provocation before reaching the disc space, that can adversely affect the result.

Interpretation of the result followed the current standards for a positive (abnormal) discogram⁽¹³⁾. These include pain that is typical or concordant to patient's clinical pain that is provoked with the injection, and the radiographic image of the disc must be abnormal. If a large volume of contrast can be injected with low resistance, the disc is degenerated or a fissure extends through the outer annulus.

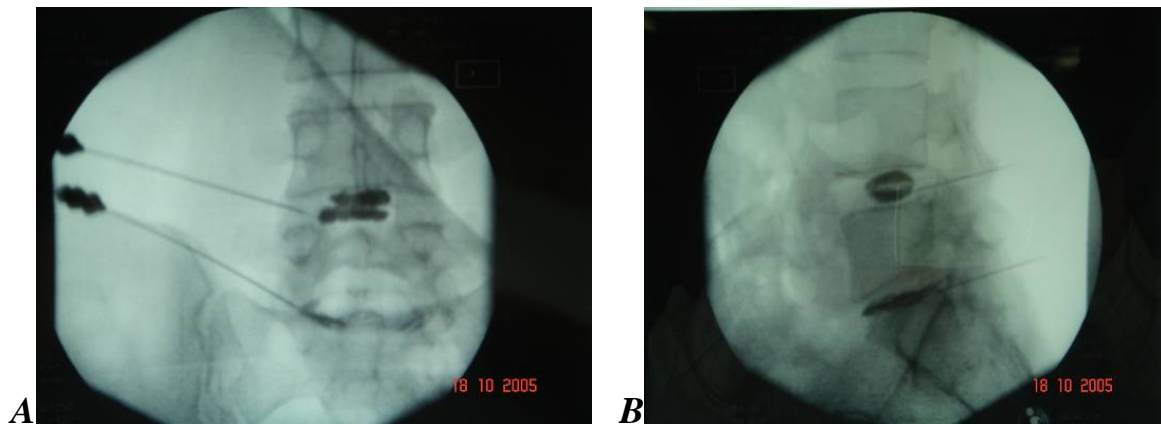


Fig.(3): A: anteroposterior and B: lateral views during provocative lumbar discography, showing early degeneration at L4/5 level (bilobed) and advanced degeneration with posterior annular tear at L5/S1.

RESULTS

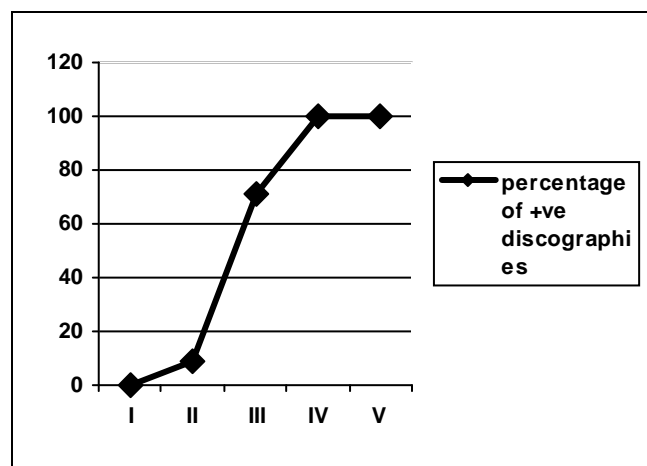
Our results are summarised in table 1 and graph 1.

It was found that the higher the grade of disc degeneration, the more likely it would be painful on provocative discography. All discs

showing Pfirrmann grades IV and V produced typical or concordant pain on discography. Statistical analysis showed a high correlation between the severity of DDD on MRI scan and the result of the provocative discography (Chi2 = 32.96, P<0.001 and correlation coefficient = 0.756).

Table 1: Number of discs and percentage of positive discographies per each Pfirrmann grade

Pfirrmann grade	I	II	III	IV	V
Number of discs	24	33	63	27	15
+ve pain provocation (%)	0	9.1	71.4	100	100



Graph 1: The higher the grade of disc degeneration, the more likely it will be painful on discography

DISCUSSION

Few previous studies graded the severity of lumbar DDD on MRI⁽³⁰⁻³²⁾. Grading was either based on describing the changes taking place in the posterior part of the disc (normal, bulge, protrusion and extrusion)⁽³¹⁾, or the internal morphological changes of the disc^(30, 32). None of these studies correlated the severity of disc degeneration on MRI with patients' symptoms. Given that disc degeneration on MRI can be frequently seen in asymptomatic subjects, these studies could not help the clinician in decision making.

In the current study we used Pfirrmann's system for two reasons. Firstly, it has been done on fast spin-echo images (FSE) as opposed to the conventional spin-echo images used in earlier studies. Disc disease may not have exactly the same signal characteristics on these two types of sequences. The FSE is the recent, widely used, MRI technique and the one used in our study. Secondly, it has been validated and found to be reliable with substantial to excellent intra and inter-observer agreements⁽³⁰⁾.

A number of previous studies compared or correlated MRI with lumbar discography^(28,29,33-35). Among those, the earlier two^(33,34) only compared the two modalities regarding their ability to detect disc degeneration, without correlating the MRI images with the pain provoked by discography. This was done in the later studies^(28,29,35), but none of these studies used a validated MRI classification system for the severity of lumbar DDD. Accordingly, it was not possible by these studies to detect the incidence of painful discs among the different degrees of severity of lumbar DDD.

In early discography studies it was found that normal discs produced significant pain^(15,16). However, at the time of these studies, MRI was not used to show the internal disc structure and we believe that the normality of the discs was inaccurately judged based on plain x-ray appearance and the contrast pattern during discography. Pfirrmann grades II and III demonstrate early disc degeneration (fig.2) which can show no detectable abnormalities on plain x-ray and can coincide with Adam's grade 2 discography that is considered normal (fig.1). Those two grades showed positive provocative discographies in 9.1% and 71.4% respectively in the current study. In addition to that, pain may have been provoked by inadvertent touching of other pain sensitive structures during placement of the needle. In the current study, using the technique mentioned before, it was possible to avoid inadvertent pain provocation before the actual placement of the needle inside the investigated disc space.

An interesting information in our results was that all discs showing Pfirrmann grade IV and V degeneration produced typical or concordant pain on provocative discography. We feel that this information is very important as a step towards stopping the use of discography to prove discogenic pain in those two grades and relying solely on MRI. However, we think that research on a wider scale, focusing on large numbers of those two grades is needed before one can recommend, on solid basis, that discography is not required.

CONCLUSION

The higher the grade of DDD, the more likely it will be painful on

provocative discography. All discs showing Pfirrmann grade IV and V disease produced typical or concordant pain on discography. We strongly recommend the Pfirrmann classification for use in grading the severity of lumbar DDD especially when assessing for its association with discogenic pain as determined by provocative discography. An interesting follow up to our research is to study the result of provocative lumbar discography in Pfirrmann grades IV and V on a wide scale.

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دراسة العلاقة بين مقدار التآكل بالغروف القطنى, باستخدام تقسيمة موثقة, و الألم الناتج عن حقن موضعى للصبغة الإشعاعية داخل الغضروف

أشرف صلاح عنبر, كاي لام

وحدة العمود الفقرى بمستشفى جاى- لندن- المملكة المتحدة

حاول الباحثون عبر عقود متوالية التعرف على الغضروف القطنى المسبب للألم أسفل الظهر. و قد كان ذلك من خلال طريقتين. الأولى عن طريق فحص الأشعات و الرنين المغناطيسى و الثانية عن طريق حقن صبغة داخل الغضروف تحت جهاز الأشعة, و لم تغن إحدى الطريقتين عن الأخرى.

الغرض من هذا البحث هو محاولة إيجاد علاقة بين درجة التآكل بالغضروف القطنى الظاهرة بأشعة الرنين المغناطيسى, باستخدام تقسيمة فيرمان, و حدوث ألم عند حقن الصبغة بالغضروف تحت جهاز الأشعة, أملين أن يؤدي ذلك إلى التعرف بشكل أكثر دقة على الغضروف القطنى المسبب للألم أسفل الظهر.

تمت الدراسة على 69 مريض (45 امرأة و 24 رجل) بمتوسط أعمار 38,9. و قد أظهرت أشعات الرنين لجميع هؤلاء المرضى تآكل غضروفى قطنى, وتم حقن 162 غضروف قطنى بالصبغة تحت جهاز الأشعة باستخدام طريقة معينة لتفادى المفصل المفلطح الخلفى.

أعتبرت نتيجة الحقن إيجابية إذا أدى الحقن إلى نفس الألم أو ألم كثير الشبه بالألم اللذى يشعر به المريض. و قد تم حساب النسبة المئوية لحالات الحقن الإيجابية لكل درجة في تقسيمة فيرمان, و تم عمل التحليل الإحصائى بواسطة إختبارى كاي سكوارد و سبيرمان.

أظهرت النتائج أن النسبة المئوية لحالات الحقن الإيجابية كانت صفر% و 9,1% و 71,4% و 100% و 100% لكل درجة في تقسيمة فيرمان على الترتيب, كما أظهر التحليل الإحصائى وجود علاقة قوية بين درجة التآكل بالغضروف القطنى و ظهور الألم الحقيقى عند حقن الصبغة داخل الغضروف, و قد ظهر هذا الألم فى جميع حالات الدرجة الرابعة و الخامسة من تقسيمة فيرمان.

