

## Magnetic resonance imaging-based interpretation of degenerative changes in the lower lumbar segments and therapeutic consequences

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### Abstract

Intervertebral disc degeneration and facet joint osteoarthritis of the lumbar spine are, among others, well

known as a cause of low back and lower extremity pain. Together with their secondary disorders they set a big burden on health care systems and economics worldwide. Despite modern imaging modalities, such as magnetic resonance imaging, for a large proportion of patients with low back pain (LBP) it remains difficult to provide a specific diagnosis. The fact that nearly all the lumbar structures are possible sources of LBP, may serve as a possible explanation. Furthermore, our clinical experience confirms, that imaging alone is not a sufficient approach explaining LBP. Here, the Oswestry Disability Index, as the most commonly used measure to quantify disability for LBP, may serve as an easy-to-apply questionnaire to evaluate the patient's ability to cope with everyday life. For therapeutic purposes, among the different options, the lumbar facet joint intra-articular injection of corticosteroids in combination with an anaesthetic solution is one of the most frequently performed interventional procedures. Although widely used the clinical benefit of intra-articular steroid injections remains controversial. Therefore, prior to therapy, standardized diagnostic algorithms for an accurate assessment, classification and correlation of degenerative changes of the lumbar spine are needed.

**Key words:** Low back pain; Spine; Intervertebral disc disease; Facet joint osteoarthritis; Magnetic resonance imaging; Oswestry Disability Index

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**Core tip:** Low back pain, caused by intervertebral disc degeneration (IDD) and facet joint osteoarthritis (FJOA), is a widely spread musculoskeletal disorder in all ages worldwide. Although IDD and FJOA are common findings on lumbar magnetic resonance-imaging, the relationship between imaging findings and clinical pain-presentation

as well as the benefit of different therapeutic options often remains unclear. This article briefly reviews the correlation of IDD and FJOA with clinical pain scores and discusses possible treatment options of FJOA with focus on the intra-articular injection of corticosteroids.

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## INTRODUCTION

Among others, intervertebral disc degeneration (IDD) and facet joint osteoarthritis (FJOA) have been identified as causes for low back pain (LBP). Magnetic resonance imaging (MRI) is the imaging method of choice for the evaluation of IDD and FJOA of the lumbar spine<sup>[1,2]</sup>. For the grading of IDD of the lumbar spine Pfirrmann *et al*<sup>[3]</sup> proposed a MRI-based 5-point scale which is based on MRI signal intensity, disc structure, distinction between nucleus and annulus and disc height on T2-weighted, midsagittal images. Due to its more precise demonstration of bony details computed tomography (CT) often is the preferred modality in the evaluation of FJOA. Weishaupt *et al*<sup>[4]</sup> evaluated the significance of MRI in comparison to CT using an established 4-point scale. In summary, the authors conclude that an additional CT scan is not required in the presence of a MRI examination. Due to the fact that nearly all lumbar structures are possible sources of LBP, for a large proportion of patients it remains difficult to provide a specific diagnosis. The Oswestry Disability Index (ODI) is the most commonly used measure to quantify disability for LBP<sup>[5]</sup> and could reflect the relationship between pain and increasing grades of IDD and FJOA. If FJOA is identified as source of pain, multiple therapeutic options have been described and established<sup>[6]</sup>. Among the different options, the lumbar facet joint (LFJ) intra-articular injection of corticosteroids in combination with an anaesthetic solution is one of the most frequently performed interventional procedures<sup>[7]</sup>. The theory of this particular therapeutic approach is based on the idea that there is inflammation of the synovial structures of the degenerated facet joints. Thus intra-articular steroid injection is performed to generate an anti-inflammatory effect in order to achieve pain relief. Although widely used the clinical benefit of intra-articular steroid injections remains controversial<sup>[8]</sup>. The aim of the presented article is to highlight the relationship of increasing grades of IDD/FJOA and clinical pain scores and to discuss therapeutic success of minimally invasive therapeutic procedures, such as intra-articular steroid injections in degenerated facet joints.

## SOURCES OF BACK PAIN

### FJOA and pain correlation

Since the facet joints are the only synovial joints in the spine with hyaline cartilage overlying subchondral bone, a synovial membrane and a joint capsule, they develop degenerative changes that are equivalent to other peripheral joints. Different studies reported contradicting results about the prevalence of FJOA at lumbar levels. Kalichman *et al*<sup>[9]</sup> reported that FJOA is more prevalent at L4/5 (45.1%) followed by L5/S1 (38.2%) and L3/4 (30.6%) whereas Abbas *et al*<sup>[10]</sup> describe a different descending order: L5/S1 (55%), L4/5 (27%) and L3/4 (16%). Additionally, Abbas *et al*<sup>[10]</sup> describe that FJOA is an age dependant phenomenon, which increases cephalocaudally, whereas they found no correlation of FJOA with sex or the Body mass index. For the assessment of FJOA our group applied the 4-point scale as proposed by Weishaupt *et al*<sup>[4]</sup> on approximately 2400 facet joints of the lumbar segments L4/5 and L5/S1. Assuming that grade I changes already represent mild degenerative changes, nearly all patients in our study group showed degenerative alterations of the facet joints (97% L4/5; 98% L5/S1). In 150 patients Ashraf *et al*<sup>[11]</sup> classified degenerative changes of the lumbar spine on lateral radiographs according to the criteria of Kellgren and Lawrence. Additionally, functional disability was measured using the ODI. They found no significant correlation between the morphological severity of osteoarthritis and ODI scores. Peterson *et al*<sup>[12]</sup> evaluated 172 consecutive patients with LBP. Lumbar radiographs were judged with regard to the severity of disc and facet joint degeneration. Results were correlated with the data of the ODI. The authors describe a weak correlation between the values of LBP and radiologically assessed lumbar spine degeneration. A major limitation of the mentioned studies is the fact that degenerative changes of the cervical and lumbar spine were graded on plain film radiographs, which are because of superposition of limited diagnostic value. Additionally, severity of degeneration of intervertebral discs as well as of facet joints was taken into account for scoring. As already mentioned nearly all-lumbar structures are possible sources of LBP, so that an isolated contemplation of anatomic structures (facet joint, intervertebral disc) and their degenerative changes with regard to clinical importance is necessary. Therefore we correlated degenerative changes of facet joints at lumbar levels L4/5 and L5/S1 with the ODI. Our results demonstrate that there is only a weak correlation between signs of degeneration and clinical disability scores as evaluated by ODI. Taking into account that a huge majority of patients of all ages show degenerative changes of facet joints in the lower motion segments of the lumbar spine, these results should be considered in the future evaluation of lumbar MRIs. In the presence of other degenerative changes like IDD, osteochondrosis or Morbus Bastrup the finding of FJOA shouldn't be



Figure 1 Computed tomography-guided puncture of the facet joints at lumbar levels L4/5 showing the needle trajectory.

considered evidentiary as the cause of LBP. In fact, the presented results seem to prove that chronic LBP is a multifactorial disorder, which cannot be explained with a constricted view on one lumbar compartment.

### IDD and pain correlation

It is widely accepted that IDD of the lumbar spine is one of the main cause of lower back pain<sup>[13,14]</sup>. The etiology of IDD is not fully explained - heavy physical loading<sup>[15]</sup>, overweight<sup>[16,17]</sup>, vibrations during vehicle driving<sup>[18]</sup> and smoking<sup>[19]</sup> have been suggested to be associated with IDD. Since radiological features of IDD are almost universal in adults, it often remains unclear to what extent these changes are responsible for the clinical symptoms of the patient. From the radiological point of view, in the first place a standardized nomenclature in the evaluation of intervertebral disc alterations is needed. Pfirrmann *et al*<sup>[20]</sup> proposed a morphologic grading system which is based on MRI T2-weighted sagittal imaging and showed a good intra- and interobserver reliability. The grading system reflects the loss of proteoglycan concentration<sup>[20]</sup> in the nucleus pulposus of the lumbar disc, which goes along with a decreasing signal intensity in T2-weighted imaging. The experience of our group confirms the fact that IDD is a general finding in MRI of the lower (L4/5 and L5/S1) lumbar segments even in young-aged patients. The vast majority of examined patients presents with Pfirrmann grade II - grade IV changes, whereas a relatively low percentage of lumbar discs present with grade V changes. Only a small number of lumbar discs show no degenerative changes. These experiences impressively illustrate the dilemma to rate the clinical symptoms of the patient correctly, based on a pervasive imaging finding. In consensus to the above mentioned results regarding the correlation of FJOA and ODI scores, also the presence of IDD in lumbar MRI can't be considered evidentiary as a reason for LBP.

### LFJ intra-articular steroid injections

LFJ intra-articular injections of corticosteroids in combination with an anaesthetic solution is one of the most frequently performed interventional procedures worldwide<sup>[7]</sup>. The theory of this particular therapeutic approach is based on the idea that there is inflammation

of the synovial structures of the degenerated facet joints. Thus intra-articular steroid injection is performed to generate an anti-inflammatory effect in order to achieve pain relief. Although widely used the clinical benefit of intra-articular steroid injections remains controversial<sup>[8]</sup>. Lakemeier *et al*<sup>[21]</sup> compared the effectiveness of intra-articular steroid injections and radiofrequency denervation in relief of LBP associated with L3/L4 - L5/S1 FJOA<sup>[21]</sup>. They investigated the therapeutic effect of aforementioned interventional procedures in a cohort of 56 patients randomized in two therapeutic groups. In their double-blinded study the authors found no significant differences in the therapeutic success between the two procedures over a follow-up period of 6 mo. Ribeiro *et al*<sup>[22]</sup> compared the therapeutic success of intra-articular steroid injection vs intramuscular steroid application in patients with facet joint-related CLP. The experimental group received bilateral intra-articular steroid injection of segments L3/4 - L5/S1 (in total 6 injections), while the control group received 6 intramuscular injections on bilateral surface points of the paravertebral lumbar musculature. Both treatments were effective over the follow-up period of 6 mo compared to the baseline. Regarding pain - relief no significant difference between the procedures was observed. It is well known that besides technical modifications many additional factors are involved in therapeutic outcome. Gryll *et al*<sup>[23]</sup> reported about situational factors contributing to placebo effect during oral surgery (status of communicator of drug effects, attitude of dentist, attitude of dental technician and message of drug effects). Among the four variables only the attitude of the dentist and the dental technician led to a statistically significantly reduced fear of injection and lower ratings of pain experience from mandibular-block injection. Initial results of our group show, that the therapist's attitude and empathy may increase the therapeutic effect of LFJ intra-articular steroid injections in patients suffering from chronic LBP. Therefore, we performed a CT-guided puncture (Figure 1) of the facet joints at lumbar levels L4/5 or L5/S1, followed by an injection of a mixture of 4 mL of 0.5% bupivacaine and 1 mL of triamcinolone acetate (20 mg). After the therapeutic procedure we encouraged the patients of an experimental group to ask questions about the procedure and showed them representative CT-images. Patients of the control group left the interventional unit without further contact with the interventional radiologist. The initial results show a significant effect on pain relief during the early post-interventional phase in the experimental group as compared to the control group. It seems that in patients who better understand therapies applied on them, an increase in therapeutic efficacy can be observed. Explanatory behind the higher efficacy might be the phenomenon of hetero-suggestion, which occurs during the post-interventional patient-radiologist dialog during image presentation and might be conveying a message into the subconscious<sup>[24]</sup>. This shows how the open and transparent handling can lead to a strong therapeutic alliance between patients and physicians for the benefit of patients.

## CONCLUSION

Age-dependent IDD and FJOA of the lumbar spine is reliably detected by MRI. The lack of significant correlation of IDD and FJOA with clinical pain scores such as the ODI confirms our experience that imaging alone is an insufficient approach explaining LBP. Clinical correlation is not an adjunct only but imperative for an adequate clinical approach in patients with LBP and lower extremity pain. Thus further studies are needed to correlate imaging data and clinical scores such as the Oswestry disability index. Among the different options for the treatment of LFJ-associated LBP, the intra-articular injection of corticosteroids and anaesthetic solutions is one of the most frequently performed procedures. Beside technical modifications it seems that patients who better understand therapies applied on them experience an increased therapeutic efficacy. This could be helpful in the daily clinical routine, where psychological phenomena such as hetero-suggestion can be used as a powerful and easy-to-apply tool, to support therapeutic procedures such as intra-articular injections.

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