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Degenerative Magnetic Resonance Imaging Changes in Patients With Chronic Low Back Pain

A Systematic Review

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Study Design. Systematic review.

Objective. To systematically search for critically appraise and summarize studies that (1) evaluated the association between degenerative magnetic resonance imaging (MRI) changes and chronic low back pain (CLBP) and (2) compared surgical and nonsurgical treatment of these degenerative MRI changes.

Summary of Background Data. The role of routine MRI in patients with CLBP is unclear. It is also uncertain whether or not surgical treatment of degenerative MRI changes results in alleviation of back pain.

Methods. Systematic literature searches were conducted in PubMed for studies published through March 1, 2011. To evaluate whether MRI degenerative changes are associated with CLBP, studies that were designed to compare the prevalence of MRI changes among subjects with and without CLBP were sought. The prevalence odds ratio was used to compare the odds of degenerative MRI findings in subjects with CLBP to the odds of such findings among those without CLBP. To evaluate whether surgical treatment of degenerative MRI changes is associated with different outcomes compared with nonsurgical treatment, comparative studies were sought. The GRADE system as applied to describe the strength of the overall body of evidence.

Results. Regarding the association of degenerative changes on MRI and CLBP, five studies were included, all of which were cross-sectional in design. On the basis of these studies, a statistically significant association was found in all but one study regarding the presence of disc degeneration and CLBP (odds ratio range: 1.8–2.8). The overall strength of evidence across studies was considered to be insufficient, however. No comparative studies of surgical *versus* nonsurgical treatment of degenerative MRI changes were identified.

Conclusion. Although there may be an association between degenerative MRI changes and CLBP, it is unknown if these estimates accurately represent the association given the quality of included studies, lack of a direct link between degenerative MRI changes and CLBP, and heterogeneity across studies. Thus, a strong recommendation against the routine use of MRI for CLBP evaluation is made. Since there are no data evaluating the efficacy of the surgical treatment of degenerative MRI changes, a strong recommendation is made against the surgical treatment of CLBP based solely upon degenerative MRI changes.

Clinical Recommendations. Recommendation 1: There is insufficient evidence to support the routine use of MRI in patients with CLBP. Recommendation: Strong

Recommendation 2: Surgical treatment of CLBP based exclusively on MRI findings of degenerative changes is not recommended. Recommendation: Strong

Key words: magnetic resonance imaging, MRI, chronic low back pain, treatment, surgery, prevalence, association. **Spine 2011;36: S43–S53**

Chronic low back pain (CLBP) is a difficult problem to treat, and the diagnosis of its exact etiology can be elusive.[1,2] Although the term describes a symptom, not a diagnosis, this one symptom nonetheless represents the constellation of diagnostic and therapeutic difficulties of a disease. *CLBP* is defined as low back pain (LBP) lasting for 3 months or more that does not emanate from a clearly defined pathologic entity, such as a deformity, fracture, neural compression, neoplasm, or infection. Symptomatic neural compression causing buttock or back pain may mimic CLBP, but because it is actually neurogenic in etiology, it is excluded from the definition from CLBP. Difficulties in managing CLBP

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lie both in the diagnosis and in the treatment. The diagnostic dilemma stems from the inability to localize and identify the source of the pain; the big question usually posed in CLBP is, "Where is the pain coming from?" The treatment dilemma arises from the lack of a well-defined and reproducible treatment modality that definitively and reliably alleviates CLBP.

From the diagnostic perspective, workup of patients with CLBP many times includes magnetic resonance imaging (MRI), and often-degenerative changes are seen.[3–5] The radiologist's interpretation of these MRIs includes such comments as "annular tear," "disc degeneration," "endplate changes," "facet arthropathy," and "bulging discs." These official reports many times can put both the patient and the treating professional in a quagmire; both may wonder if these multiple degenerative changes are the source of the pain. However, it is unclear if such changes are truly associated with back pain. There are patients without back pain who have degenerative MRI changes, and there are patients with back pain who do not have such changes.[6] On the contrary, studies have shown that patients with back pain tend to have more degenerative changes than patients without back pain.[5,7,8] Moreover, treatment of such degenerative MRI changes (specifically degenerative disc disease) by surgical intervention can be controversial. It is not entirely clear that surgical treatment of degenerative disc disease results in a decrease in back pain.[9]

Thus, there can be a "morbidity" associated with obtaining MRIs in patients with CLBP. Once the MRI is done, the patient now has a radiologist's report documenting a multitude of changes in their back. In the hopes of alleviating the back pain, the patient may seek to have such degenerative changes addressed, clinging to the notion that these changes are indeed the cause of their pain. The time and resources devoted to addressing these changes, either through subspecialist consultation, patient counseling, injections, or even surgery, can be significant, whether or not an intervention is performed.[10,11] Much of this morbidity may be related to patient and primary care provider expectation. When the patient presents with back pain and an MRI is obtained, then the radiologist's dictated interpretation yields multiple "findings" of normal, age-related degenerative changes, and these may connote to the patient and the primary care provider that these findings are indeed the cause of the pain. This subsequently may result in a spine surgeon referral, with the expectation that a solution can be found when, in fact, surgery may be no better than nonsurgical care. In addition, this may lead to an unintended "labeling" of the patient as having a structural abnormality when, in fact, they merely have natural, age-related degenerative changes. Patients "labeled" with such degenerative changes may tend to worry more, avoid therapeutic exercise, or focus in minor back symptoms, hampering improvement.[12] Thus, obtaining an MRI when treating patients with CLBP is not without morbidity and consequence.

Because of the lack of high-quality evidence addressing the utility of MRI for CLBP and MRI's prognostic capacity for treatment outcomes, this systematic review was performed in an effort to evaluate the best level of evidence in the literature and to come up with expert consensus clinical recommendations. This systematic review poses the following clinical questions: (1) In the absence of deformity or symptomatic neural compression, are degenerative MRI changes (*e.g.*, degenerative disc disease, facet arthropathy, bulging discs, annular tears, and endplate changes) associated with CLBP? (2) In the absence of deformity or symptomatic neural compression, is the surgical treatment of degenerative MRI changes associated with improved outcomes compared with nonsurgical treatment? Based on these findings, clinical recommendations will be made as to whether or not the routine use of MRIs in CLBP patients should be performed and whether or not surgical treatment of degenerative MRI changes is recommended.

MATERIALS AND METHODS

Electronic Literature Database

The literature search is outlined in detail in the Supplemental Digital Content 1 (http://links.lww.com/BRS/A537). In brief, systematic searches were conducted in PubMed for literature published through March 1, 2011. Results were limited to studies in humans and articles published in the English language with an abstract available. Reference lists of seminal articles were also systematically checked for relevant studies.

To evaluate whether degenerative MRI changes are associated with CLBP, studies that were designed to compare the prevalence of MRI abnormalities among subjects with and without CLBP were sought. A systematic review by Endean *et al*[13] was identified that included studies assessing whether LBP can be attributed to abnormalities on MRI. Although this review did not address the specific question of interest for this report, their literature search was considered to be reasonable and complete enough to capture relevant references published prior to August 2008. The same literature search terms and search strategy outlined in Endean was used to search for studies published since the Endean report (January 2008 to March 1, 2011). CLBP was defined as lower back pain lasting 3 or more months[14]; therefore, studies of acute back pain or LBP less than 3 months were excluded. Studies in which subjects had conditions that involved neurological compromise, tumor, trauma, deformity, or visceral or systematic diseases were excluded. In addition, studies which explicitly stated that more than 20% of subjects had excluded conditions were excluded from this report. Table 1 provides additional detail on the specific inclusion and exclusion criteria.

To evaluate whether surgical treatment of degenerative MRI changes is associated with different outcomes compared with nonoperative care, randomized controlled trials or nonrandomized observational studies with clinical controls comparing outcomes of surgical *versus* nonsurgical treatment of patients with degenerative MRI changes were sought (Table 1). Case series were excluded.

Data Extraction

Each retrieved citation was reviewed by two independently working reviewers (J.M.S.K. and A.C.S.). Most articles

TABLE 1. Inclusion and Exclusion Criteria for Questions 1 and 2

	Inclusion	Exclusion
Patients	Q1: Adults with LBP (≥3 mo duration) 18–65-yr-old with possible degenerative causes of LBP (*e.g.*, disc degeneration, facet arthropathy)	Persons < 18-yr-old Patients with LBP requiring immediate referral (*e.g.*, cauda equina) Patients presenting with acute back pain Patients with symptomatic neural compression (radiculopathy), neurogenic claudication (spinal stenosis) Sciatica, leg pain, or symptomatic neural compression Patients with tumors, trauma, primary infection or inflammatory cause, fractures, deformity (including spondylolisthesis), Paget's disease, osteochondrosis, congenital malformation, visceral diseases Patients with history of previous spine surgery Studies where duration of LBP is not clear or outcomes for CLBP (≥3 mo duration) are not separated out
	Q2: Adults with LBP (≥3 mo duration) 18–65-yr-old with findings of degenerative disease on MRI	
Intervention	Q1: MRI findings	Q1: Positional or upright MRI MRI myelography MRI with discography
	Q2: Surgical treatment	
Comparators	Q1: No MRI findings	Q1: Plain radiographs CT Discography Myelography
	Q2: Nonsurgical treatment (conservative care, medication, physical therapy, exercise, cognitive behavioral therapy)	Q2: Intradiscal electrothermal therapy, laser therapy, adhesiolysis, ENS (TENS), steroid injections, spinal cord stimulation or similar nonsurgical treatments Studies based on discography
Outcomes	Q1: Frequency of abnormal findings in symptomatic and asymptomatic patients Correlation between findings and symptoms	Incidental findings and their follow-up
	Q2: Pain relief Functional outcomes Quality of life outcomes	
Study design	Q1: Initial focus on the highest quality studies (*e.g.*, systematic reviews of high quality studies, population-based studies of prevalence and correlation with symptoms, RCTs which assess clinical outcomes incorporating the effects of test results on treatment)	Case series, case reports
		Studies of fewer than 20 patients

(*Continued*)

TABLE 1. (*Continued*)

	Inclusion	Exclusion
	Q2: Systematic reviews and studies directly comparing surgical and nonsurgical treatment of patients with MRI findings consistent with degenerative disease. In the event that no comparative studies meeting the criteria are found, high quality (criteria: consecutive patients, ≥80% follow-up, specification of MRI findings, minimum of 1 yr follow-up) case series may be sought Studies of clinical decision making	
Publication types	Full-length articles published in English in peer reviewed journals, published HTAs or publically available guidelines; government publications	Abstracts, editorials, letters Duplicate publications of the same study which do not report on different outcomes Single reports from multicenter trials Studies reporting strictly on the technical aspects Meeting proceedings and abstracts White papers Narrative reviews Articles identified as preliminary reports when results are published in later versions

CLBP indicates chronic low back pain; CT, computed tomography; ENS, electrical neural stimulation; HTA, health technology assessment; LBP, low back pain; MRI, magnetic resonance imaging ; RCTs, randomized controlled trials; TENS, transcutaneous electrical neural stimulation.

were excluded on the basis of information provided by the title or abstract. Citations that appeared to be relevant or that could not be unequivocally excluded from the title and abstract were identified, and the corresponding full-text reports were evaluated by the two reviewers. Any disagreement with respect to inclusion or exclusion of these citations was resolved by consensus. For all included studies, the following data were abstracted for subjects with and without CLBP, if available: demographics (age, sex, height, weight, body mass index, occupation, inclusion/exclusion criteria), prevalence of MRI abnormalities (disc degeneration, disc protrusion, reduced disc height, annular tear, high-intensity zone, endplate changes, modic changes, zygoapophyseal joint [Z-joint] degeneration) among subjects with and without CLBP. Definitions of LBP varied across studies. Analyses were based on the definitions that were most consistent with LBP of 3 or more months' duration.

Study Quality

Level of evidence ratings were assigned to each article independently by two reviewers (Erika Ecker and J.M.S.K.) using criteria set by *The Journal of Bone and Joint Surgery*, American Volume (*J Bone Joint Surg Am*)[15] for prognostic studies and modified to delineate criteria associated with methodological quality, which are described elsewhere.[16]

Analysis

To evaluate the presence of an association between degenerative MRI findings and CLBP, the prevalence odds ratio (OR) was used (based on the data provided in the individual studies) to compare the odds of MRI abnormality in subjects with CLBP TO the odds of MRI abnormality in subjects without CLBP. (See Table S1, Supplemental Digital Content 1, http://links.lww.com/BRS/A537.) All prevalence ORs presented are crude and do not adjust for potential confounding factors, because subject-level data on potential confounders were not provided by any study. Prevalence ORs and the corresponding 95% confidence intervals (CIs) and *P* values were calculated using the cci command in STATA (StataCorp, 2009. Stata Statistical Software: Release 11. CollegeStation, TX: StataCorp LP). Data were not pooled because of heterogeneity of subject populations, definitions of CLBP, and definitions of MRI abnormalities. Graphs of prevalence ORs and their 95% CIs were constructed. If the CI for an OR includes the value of one, the association is not statistically significant; however, if the interval excludes the value of one, the association is statistically significant.

Overall Strength of Body of Literature

Because level of evidence ratings were assigned to each article independently by two reviewers using criteria set as described earlier, this provided a baseline for the initial strength of the

overall body of evidence. It was considered "high" if the majority of the studies were level I or II and "low" if the majority of the studies were level III or IV. The strength of the body of evidence was downgraded one or two levels on the basis of the following criteria: (1) inconsistency of results, (2) indirectness of evidence, or (3) imprecision of the effect estimates (*e.g.*, wide CIs). The body of evidence was upgraded one or two levels on the basis of the following criteria: (1) large magnitude of effect or (2) dose-response gradient. The overall strength of the body of literature was expressed in terms of the confidence in the estimate of effect and the impact that further research may have on the results. An overall strength of "high" means there is high confidence that the evidence reflects the true effect. Further research is very unlikely to change the confidence in the estimate of effect. The overall strength of "moderate" means there was moderate confidence that the evidence reflects the true effect. Further research may change the confidence in the estimate of effect and may change the estimate. A grade of "low" means there was low confidence that the evidence reflects the true effect. Further research is likely to change the confidence in the estimate of effect and likely to change the estimate. Finally, a grade of "insufficient" means that evidence either is unavailable or does not permit a conclusion. A more detailed description of this process can be found in the "Methods" section of the article.[16]

RESULTS

Study Selection

For the first question, a total of 477 citations were identified. Of these, 446 were excluded by abstract and 31 were retrieved to undergo full-text review to determine whether they met inclusion criteria. After full-text review, an additional 26 articles were excluded for the following reasons: All subjects had undergone prior surgery (n = 1 study); did not meet the definition of CLBP (n = 7 studies); all subjects had LBP (n = 4); did not meet MRI criteria (n = 2); were reviews or case-reports (n = 3); all subjects selected for spinal abnormality (n = 2); estimates of prevalence of MRI abnormality were not stratified by LBP (n = 6); estimates of prevalence of MRI abnormality provided at the disc level not patient level (n = 1; Figure 1). Additional information on excluded studies is found in the Supplementary Digital Content (see Table S6, Supplemental Digital Content 1, http://links.lww.com/BRS/A537).

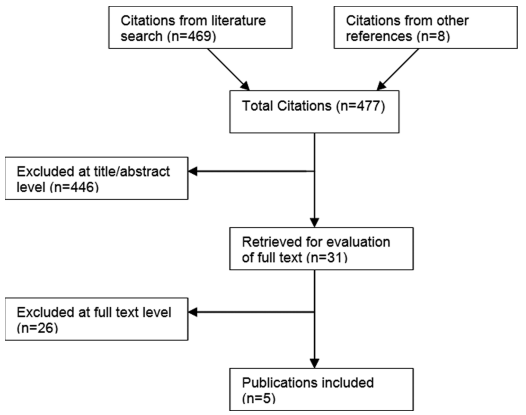

Figure 1. Flow chart showing results of literature search for Q1.

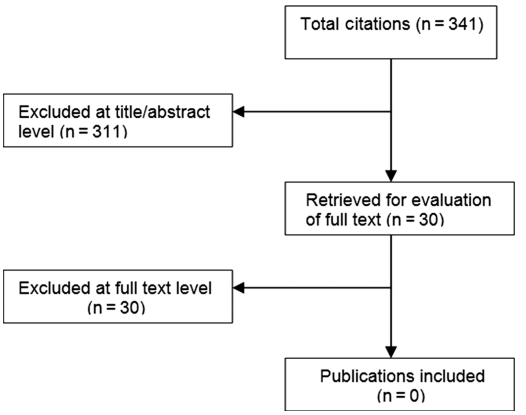

Figure 2. Flow chart showing results of literature search for Q2.

For the second question, a total of 341 citations were identified. Of these, 311 were excluded by abstract and 30 were retrieved to undergo full-text review to determine whether they met inclusion criteria. After full-text review, all 30 articles were excluded on the basis of the following primary reasons: One was a report on utilization, 27 articles were case series or compared different surgical techniques and 2 focused on patients who had excluded conditions (Figure 2).

In the Absence of Deformity or Symptomatic Neural Compression, Are Degenerative MRI Changes Associated With Back Pain?

Five articles based on four study populations reported on the association between degenerative MRI changes and CLBP that met inclusion criteria (Table 2). Two reports were population based and evaluated the same Danish population sample.[7,8] Two studies selected subjects based on occupation,[17,18] and one study provided no information on study sample selection.[19] All references provided estimates of the prevalence of disc degeneration based on MRI findings of reduced signal intensity, [7,8,17-19] two studies provided estimates of the prevalence of disc protrusion,[8,18] and one study provided estimates of several additional MRI abnormalities, including reduced disc height, annular tear, high intensity zone, endplate changes, modic changes, and Z-joint degeneration.[8] Although all studies met the inclusion criteria for a definition of CLBP, there was considerable heterogeneity across studies with respect to the definition as well as duration or frequency of CLBP. Furthermore, there was heterogeneity with respect to the definition of specific MRI abnormalities (disc degeneration, disc protrusion). All studies were cross-sectional.

In the two Danish population-based reports, by Kjaer *et al*[8] and Bendix *et al*,[7] participants were asked whether they had had "trouble with the lowest part of the back" during the past 7 days, past month, or past 12 months. In a report of an occupational cohort of men which included ambulance men, hospital porters, car production workers, draymen, and office

personnel by Savage *et al*,[17] participants were divided into the following four groups: (1) no LBP ever, (2) LBP in the past, but not the 12 months preceding the MRI scan, (3) LBP in the 12 months preceding the MRI examination, but not every month, (4) LBP at least once a month in the 12 months preceding the MRI scan. Although we selected only those who had responded that they had LBP during the past 12 months, it is not clear that respondents experienced pain consistently during that time. The two other studies more clearly indicated back pain duration as longer than 3 months.[18,19] No additional information on the duration or frequency of episodes of pain was provided. The presence or absence of leg pain and the characteristics of that leg pain (radicular or not) were not clearly reported in most studies.

Patient characteristics which might influence the presence of CLBP (*e.g.*, physical activity, body mass index) and demographic information were poorly reported in most studies. The population-based study was among 40-year-olds[8] and one study in military personnel reported a mean age of 19.8 years for participants.[18] In the occupation-based study, 52.3% of participants were 20 to 30 years old.[17] Paajanen *et al*[19] reported on the following multiple age groups: 10 to 14 years old (4.7%), 15 to 19 years old (33%), 20 to 29 years old (32%), 30 to 39 years old (12.5%), and 40 to 49 years old (16.8%).

The MRI systems used in all, but one of the studies, were lower-resolution systems of 0.2 T or less.[7,8,18,19] Only one study (Savage *et al*[17]) used a higher-resolution system (1.5 T).

The odds of CLBP given the presence of disc degeneration ranged from 1.8 to 2.8 across the four reports (Figure 3).[8,17–19] In the population-based study of 40-year-olds in Denmark (n = 412), the presence of disc degeneration was associated with significantly increased odds of LBP (OR = 2.6, 95% CI: 1.6–4.1).[8] In a separate analysis of the same study population, which used different criteria to define disc degeneration, the odds of CLBP was 0.5 (95% CI: 0.4–0.9) if the patient had gray discs but no black discs. The odds of CLBP in patients with black discs without gray discs was 2.1 (95% CI: 1.0–4.9), and the odds of CLBP in patients with both black and gray discs was 2.1 (95% CI: 1.3–3.5).[7]

Among the occupational cohort studies, the association between CLBP and disc degeneration was significant in the study among young military personnel (OR: 2.8, 95% CI: 1.4–5.5)[18] but not significant in the other study which included a range of occupations.[17] This latter study did not provide sufficient data to determine the associations between CLBP and degenerative MRI changes for individual occupations.

Paajanen *et al*[19] reported on the presence of CLBP and disc degeneration by MRI for various age groups. Estimates of the association between disc degeneration and CLBP stratified

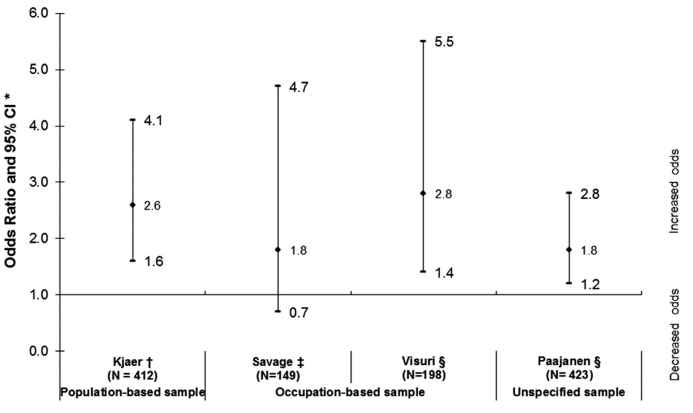

Figure 3. Odds of CLBP given the presence of MRI evidence of disc degeneration. *Confidence intervals for odds ratios that exclude the value of 1.0 are statistically significant; those which include 1.0 are not statistically significant. CLBP defined as follows: †LBP during past 12 months. ‡LBP at least once a month in the 12 months preceding MRI. §LBP lasting 12 or more weeks.

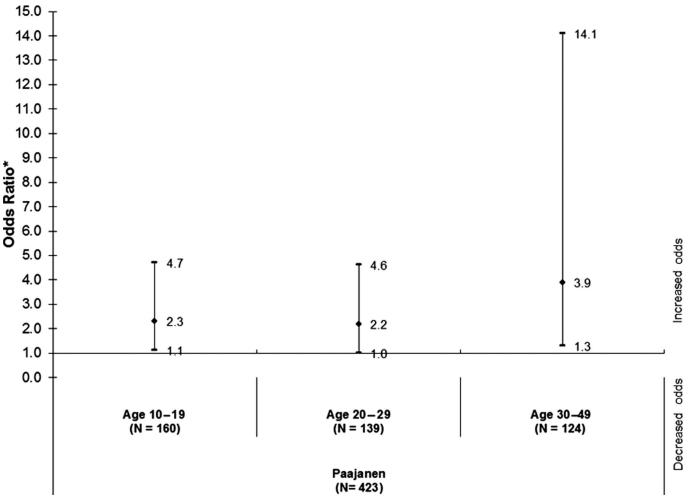

Figure 4. Odds of chronic low back pain given the presence of MRI evidence of disc degeneration stratified by age (based on one study) CLBP defined LBP lasting 12 or more weeks. *Confidence intervals for odds ratios that exclude the value of 1.0 are statistically significant; those which include the value of 1 are not statistically significant.

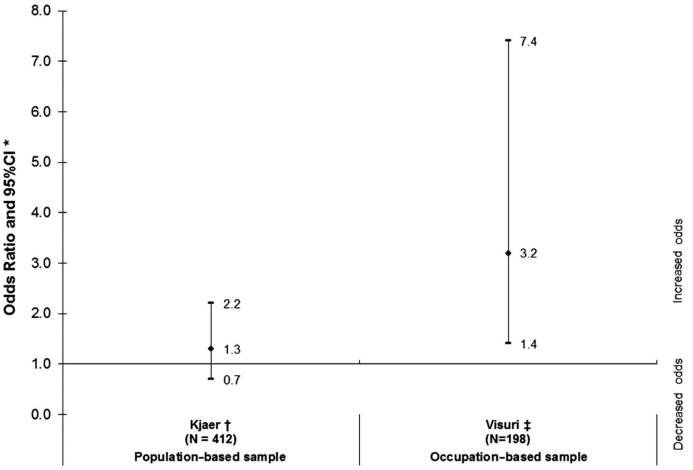

Figure 5. Odds of chronic low back pain given the presence of MRI evidence of disc protrusion. *Confidence intervals for odds ratios that exclude the value of 1.0 are statistically significant; those which include 1.0 are not statistically significant. CLBP defined as follows: †LBP during past 12 months. ‡LBP lasting 12 or more weeks.

by age were statistically significant in all age groups.[19] The odds of CLBP with degenerative discs for those 10 to 19 years old and those 20 to 29 years old were similar (OR: 2.3, CI: 1.0–4.7) but were higher (OR: 3.9, CI: 1.3–14.1) for those 30 to 49 years old. However, the CI for this group was wide (Figure 4; see Supplemental Digital Content 1, http://links.lww.com/BRS/A537).

Two studies reported the prevalence of disc protrusion[8,18]; however, the definitions differed substantially between these studies as did the participant populations (Figure 5). In the largest of these studies (N = 412)—which was population-based and consisted of 40-year-olds—the presence of abnormal disc contour (including disc protrusion, extrusion, or sequestration) was associated with a nonsignificantly increased odds of CLBP (OR = 1.3, 95% CI: 0.7–2.2).[8] In the other study, among 19- to 20-year-old military personnel, the presence of disc protrusion (defined as symmetric bulging of disc beyond the margins of vertebral body, having lost normal concavity) was associated with significantly increased odds of CLBP (OR = 3.2, 95% CI: 1.4–7.4).[18]

The population-based study by Kjaer *et al*[8] reported on the prevalence of several additional MRI abnormalities among subjects with and without CLBP (Figure 6). The presence of reduced disc height, annular tear, high-intensity zone, and modic changes were each independently associated with significantly increased odds of CLBP (reduced disc height: OR = 2.5, 95% CI: 1.6–4.0; annular tear: OR = 2.0, 95% CI: 1.3–3.3; high-intensity zone: OR = 2.5, 95% CI: 1.5–4.0; modic changes: OR = 4.2, 95% CI: 2.1–9.2). This study reported no association between the presence of endplate changes or Z-joint degeneration and CLBP (see Supplemental Digital Content 1, http://links.lww.com/BRS/A537).

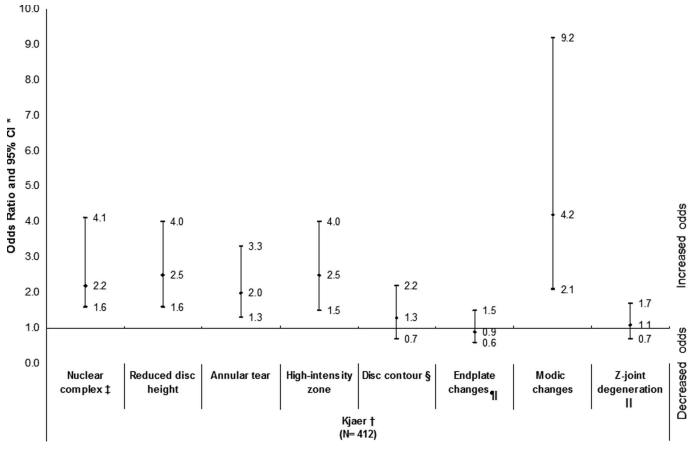

Figure 6. Odds of chronic low back pain given the presence of MRI evidence of other disc abnormalities. *Confidence intervals for odds ratios that exclude the value of 1.0 are statistically significant; those which include 1.0 are not statistically significant. †CLBP defined as LBP during past 12 months. ‡Severely irregular shape and <25% of disc area. §Protrusion, extrusion, or sequestration. ¶Defects and/or Schmori's nodes. ‖Slight or severe degeneration.

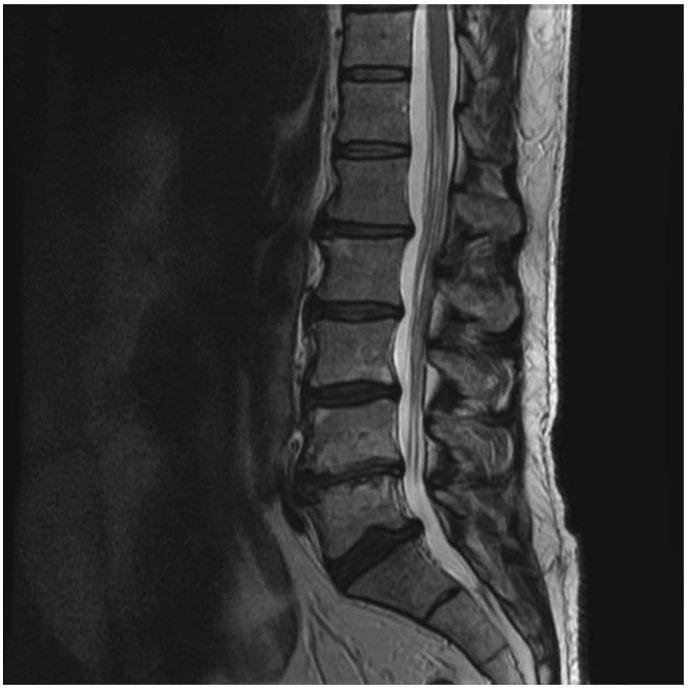

Figure 7. A sagittal T2-weighted MRI demonstrating typical degenerative changes of disc collapse and endplate changes. Additional information can be found in the Supplemental Digital Content.

In the Absence of Deformity or Symptomatic Neural Compression, Is the Surgical Treatment of Degenerative MRI Changes Associated With Different Outcomes Compared With Nonsurgical Treatment?

There were no studies, which directly compared outcomes of surgical and nonsurgical treatment of individuals based only on degenerative MRI changes as specified for this review (Figure 7).

EVIDENCE SUMMARY

The strength of the overall body of evidence based on application of GRADE[16] is summarized in Table 2. It was considered to be "insufficient" regarding the association between disc degeneration and CLBP. MRI findings of disc degeneration do not appear to represent a direct link to the presence of CLBP. Degenerative MRI changes may be present in patients without CLBP and may not be present in patients with CLPB. In addition, LBP definitions were broad and varied in the studies; there were variations in how disc degeneration was defined, and the populations were very different across studies. Moreover, cross-sectional studies do not allow for causal inference.

The strength of the overall body of evidence was considered to be "insufficient" with regard to the association between disc degeneration on MRI and CLBP for specific age groups because only one study was available (Table 3).

The strength of the overall body of evidence was considered to be "insufficient" with regard to the association between MRI findings of disc protrusion and CLBP. There is some inconsistency and imprecision as well as indirectness. One study was among 40-year-old military personnel, the other in 19-year-old military personnel.

TABLE 2. Characteristics of Retained Studies*

Author (yr)	Study Design, Sampling (LoE)	Participant Characteristics	Inclusion/Exclusion
Kjaer *et al* (2005)	Cross-sectional population-based response rate: 66% LoE III	N = 412, male: 48.3%, mean age: 40 yr	Inclusion Age: 40 yr Living in county of Funen County, and born in Denmark Exclusion Severe disability Ferromagnetic implants Claustrophobia Unable to communicate in Danish
Paajanen *et al* (1997)	Cross-sectional Sample: not stated Proportion of eligible subjects enrolled: NR LoE III	N = 423 Male: 56.6% Age groups: 10- to 14-yr-old (4.7%), 15- to 19-yr-old (33%), 20- to 29-yr-old (32%), 30- to 39-yr-old (12.5%) 40- to 49-yr-old (16.8%)	Inclusion Age range: 10–49 yr Exclusion None reported
Savage *et al* (1997)	Cross-sectionalsample selected by occupation Proportion of eligible subjects enrolled: NR LoE III	N = 149 Male: 100% Ages: 20—30 yr (52.3% Ages: 31—58 yr (47.7%) Occupation Ambulance men: 16% Hospital porter: 11% Car production worker: 27% Draymen: 8% Office staff: 38%	Inclusion Male volunteers from five different occupations that imposed different loads and stresses on the lumbar spine Exclusion Not specified
Visuri *et al* (2005)	Cross-sectional sample selected by occupation (military) Proportion of eligible subjects enrolled: NR LoE III	N = 198 Mean age: 19.8 yr Mean BMI: 23	Inclusion Age: 18–26 yr CLBP > 12 weeks receiving physiotherapy for pain Exclusion Not specified
Bendix *et al* (2008) (Same population as Kjaer *et al*)	Cross-sectional Population based Response rate: 66% LoE III	N = 412 Male: 48.3% Age: 40 yr	As earlier for Kjaer *et al*

*Based on data reported by authors. Additional study detail available in the Supplemental Digital Content.

LoE indicates level of evidence; NR, not reported; BMI, body mass index.

The strength of the overall body of evidence was considered to be "insufficient" with regard to whether surgical treatment of degenerative MRI changes (as defined by the inclusion/exclusion criteria) is associated with different outcomes compared with nonsurgical treatment. No studies that directly compared these treatment options in the same underlying population were found to specifically address this question.

DISCUSSION

Degenerative MRI changes are present in both patients with CLBP and in patients without it. Although the data do suggest that patients with back pain tend to have a higher prevalence of degenerative changes on MRI, it is unclear if these degenerative changes are indeed the cause of the back pain based on these cross-sectional studies. Even with the observed association of certain degenerative MRI changes with CLBP, it is not an absolute direct link. Furthermore, obtaining an MRI to discover such degenerative changes does not necessarily result in alteration of treatment. However, it should be emphasized that clinical suspicion of such worrisome pathologies as infection or neoplasm, based on a thorough history and physical examination should not preclude obtaining an MRI. In addition, the presence of neurologic symptoms should warrant an MRI, depending upon clinical presentation, and patients with neurologic symptoms should not be treated in the same category as patients with CLBP. In the absence of other clinical factors that would raise the suspicion for other pathologic processes, the yield of routine MRI for CLBP is low.

Although there have been studies evaluating the surgical treatment of LBP, there is no study that has based this surgical

TABLE 3. Overall Body of Evidence Summary

All AHRQ-"required" and "additional" domains* are assessed. Only those that influence the baseline grade are listed in the table
Baseline strength: Risk of bias (including control of confounding) is accounted for in the individual article evaluations. High = majority of articles level I/II. Low = majority of articles level III/IV
Downgrade: Inconsistency† of results (1 or 2); Indirectness of evidence (1 or 2). Imprecision of effect estimates (1 or 2)
Upgrade: Large magnitude of effect (1 or 2); Dose-response gradient (1)

	Key question 1. In the absence of deformity or symptomatic neural compression, are MRI findings of degenerative disease (such as degenerative disc disease or facet arthropathy) associated with back pain?	
Outcome	**Strength of Evidence**	**Conclusions/Comments**
Odds of CLBP with MRI findings of disc degeneration	Insufficient	Odds of CLBP when MRI findings of disc degeneration ranged from 1.8 to 2.8 across four cross-sectional studies in different populations but CIs were moderately wide in two studies; one study did not reach statistical significance
Odds of CLBP with MRI findings of disc degeneration (specific age groups)	Insufficient	Odds of CLBP with MRI findings of disc degeneration from 1 study suggest that those 30–49-yr-old had greater odds, but the CI is wide
Odds of CLBP with MRI findings of disc protrusion	Insufficient	Odds of CLBP when MRI findings of disc protrusion ranged from 1.3 to 3.2 across two cross-sectional studies, but CIs were moderately wide in one study, one did not reach statistical significance
Key question 2. In the absence of deformity or symptomatic neural compression, is surgical treatment of MRI findings of degenerative disease associated with different outcomes compared to nonsurgical treatment?		
Outcomes NA	Insufficient	No comparative studies found

**Required domains: risk of bias, consistency, directness, and precision. Plausible confounding that would decrease observed effect is accounted for in our baseline risk of bias assessment through individual article evaluation. Additional domains: dose-response, strength of association, publication bias.*

†Single study = consistency unknown.

CI indicates confidence interval; CLBP, chronic low back pain; MRI, magnetic resonance imaging; NA, not applicable.

treatment exclusively on MRI findings. Many of these studies also included discography, computed tomography (CT), or plain radiographs to evaluate criteria for surgical treatment. Since our systematic review focused specifically on degenerative MRI findings, we excluded all of these studies. This is reflective of both the difficulty in identifying a cause of CLBP and the limitations of MRI in this setting.

Strengths of this study include the systematic approach to searching for and evaluating relevant studies to answer a well-defined clinical question. Combined with use of specified inclusion/exclusion criteria defined *a priori*, this approach enhances the validity of this report and facilitates identification of specific gaps in understanding if degenerative MRI changes are associated with CLBP.

This review suggests that findings of degenerative disc changes on MRI may be associated with CLBP. However, several limitations must be kept in mind. First, the included studies were cross-sectional, and in such studies it is not possible to know how long the MRI findings would have been present relative to the timing (or real duration) of the back pain. In other words, the temporal sequence of findings and symptoms (or symptom duration) is not known; thus, no causal inference can be made. Second, the definitions of CLBP varied across studies and the presence, absence, or characteristics of any associated leg pain were poorly reported. Concerns related to definitions of CLBP and inclusion of two articles were resolved by consensus. The first article, by Savage *et al*,[17] had a heterogeneous group of patients with differing times of back pain, separated into four groups. Group number 4 was defined as patients having back pain for the past 12 months at least once a month. This last group met our definition of CLBP and these data could be culled from the manuscript separately. The second article, by Kjaer *et al*,[8] included patients with back pain in the, "past 7 days," "past month," and "past 12 months." Only data from the later group were included in these analyses as this definition was most likely to capture those with CLBP. However, it is possible that those with more acute LBP were among the respondents in this group. It appears that the OR estimates and CI ranges for this group (Figure 3) are reasonably consistent with other studies whose definitions were more closely aligned with our CLBP definition. This may suggest that the group is likely to have captured those with CLBP. The primary strength of the article by Kjaer *et al*[8] is that it is population-based and includes a

broad spectrum of people, allowing for a better determination of the true prevalence of CLBP in this population of 40-year-olds. It was the only population-based study found that had a group that was likely to include CLBP and that had evaluated the association between degenerative MRI changes and CLBP; it was therefore retained. Even though a statistically significant association between various MRI changes and back pain was observed for the Kjaer *et al*[8] data, it is unclear how much of this association may be attributable to those with CLBP as defined in our article.

Definitions of CLBP that appeared to most closely reflect the inclusion/exclusion criteria for this review were chosen. However, a degree of misclassification of individuals (in all studies) with regard to those criteria is likely because those definitions still lacked the precision needed to explicitly delineate persons with CLBP as defined for this article. Similarly, there were differences in how MRI findings were defined. The terms used for degeneration were not consistent across all studies. Another factor relates to the resolution of the MRI equipment used in most studies; all but one study used MRI strengths of 0.2 T or less. The extent to which this may influence the delineation of specific MRI findings is not clear. Finally, the prevalence ORs presented are crude and do not adjust for potential confounding factors which may be associated with both CLBP and degenerative MRI changes. We are not able to calculate adjusted ORs since subject-level data on potential confounders was not provided by any study. None of the studies presented adjusted estimates, but one did stratify results by age group.

The absence of comparative studies evaluating outcomes of surgical treatment compared with nonsurgical treatment in patients with degenerative MRI changes precludes us from making any conclusions on the efficacy of such surgical treatment. Many noteworthy studies have been published regarding surgical *versus* nonsurgical studies for back pain; however, these do not exclusively base their inclusion criteria on MRI, which is our specific clinical question.[20] Many of these studies included discography, plain radiographs, or CT to identify possible pain generators; such studies did not exclusively use MRI for preoperative evaluation.

Many papers, which have evaluated degenerative MRI changes and CLBP or CLBP and surgical treatment failed to meet our inclusion criteria for various reasons. For instance, in a recent study by Ohtori and coworkers,[21] participants with discogenic LBP of at least multiyear duration, specific MRI findings of degenerative disease, and positive discogram or discoblock were randomized to surgery or minimal treatment. In this small study (N = 41) of highly selected patients, at 2 years posttreatment, surgical patients had significantly improved visual analog scale, Japanese Orthopedic Association, and Oswestry Disability Index scores.[21] These results may not be generalizable to patients who did not have positive discogram or discoblock. Because our review excluded discography and only focused on MRI changes, we did not include this manuscript. In addition, other studies, which have shown improvement in patient outcomes after the surgical treatment of LBP, did not base treatment exclusively on MRI changes (discography and CT were also used).[20] Several articles reported estimates of the prevalence of MRI abnormalities among healthy individuals without LBP[4,6,22,23]; however, they did not provide comparison prevalence estimates among individuals with CLBP, precluding calculation of a prevalence odd ratio. In addition, the prevalence of MRI abnormalities in persons without LBP in these studies was high:

1. Kanayama *et al*: MRI abnormalities in up to 60% to 80%; up to 50% of discs had evidence of herniation, Schmorl's nodes in 4.0% to 9.5% and high-intensity zone in 10% to 24% of discs, up to 35% had herniation.[4]
2. Jensen *et al*: Sixty-four percent had abnormalities at one or more level; 52% had bulge at one or more level, 27% had protrusion, 1% had extrusion; 19% Schmorl's nodes.[6]
3. Boden *et al*: Twenty-eight percent had a substantial abnormality; 24% had herniated disc.[22]
4. Borenstein *et al*: At baseline 36% had one or more abnormal MRI finding (16% herniation, 8% stenosis, 12% disc bulge, 4% degeneration).[23]

Other recent studies not only evaluated the association of degenerative MRI changes and back pain but also failed to meet our inclusion criteria. Cheung *et al*[3] reported MRI changes and back pain in more than 1000 individuals. This study was excluded, however, because back pain was defined as, "pain in the low back of more than 2 weeks duration," which does not meet our criteria of CLBP (defined as LBP for 3 months or more). Carragee *et al*[24] also reported a study evaluating the association between back pain and MRI changes. This study followed patients for 5 years to see if first time episodes of back pain were associated with MRI changes. Their definition of back pain was pain more than 1-week duration, which failed to meet our definition of CLBP.[24] Jarvik *et al*[25] evaluated back pain in initially asymptomatic for 3 years. In those 3 years, 67% of patients had an incidence of pain; however, they included radiculopathy in their definition of pain. Moreover, 20% had either stenosis or spondylolisthesis. Thus, because of the radicular nature and deformity (spondylolisthesis) of many of these patients, it failed to meet our inclusion criteria of CLBP and was excluded.[25] Finally, Takatalo *et al*[5] reported on the association between disc degeneration and LBP. They found that although there is more of an association of back pain with moderately degenerated discs than mildly degenerative discs, one-third of asymptomatic patients had degenerated discs. Moreover, the patients were categorized by cluster analysis, and this did not allow us to extract the data to evaluate the association between degenerative MRI changes and CLBP based on definitions set forth in the methods.[5]

Although a statistically significant association was noted between the presence of disc degeneration on MRI and CLBP, it is questionable if the estimates accurately represent the association. This is largely due to the overall quality of studies found and the lack of a direct link between degenerative MRI changes and CLBP. In addition, heterogeneity across studies with regard

to the imaging and clinical phenotypes, definitions of MRI findings, populations, and sampling methods need to be considered. This heterogeneity, combined with concerns regarding study quality and design, precluded meaningful statistical pooling of data. Despite the observation of a statistical association between some MRI changes and CLBP in the included studies, the clinical significance of degenerative findings is unclear. These considerations prevented us from advocating routine MRI use in patients with CLBP based on the current evidence.

Only limited conclusions based on the association of degenerative MRI findings and CLBP are possible in this study because all studies were cross-sectional in design; thus causal relationships cannot be assessed. Methodologically rigorous longitudinal prospective studies (preferably population-based) that use precise definitions of CLBP and predefined criteria for MRI changes need to be conducted to confirm and better define the relationship between specific MRI changes and development of CLBP. Similarly, rigorous studies that compare the outcomes of patients from the same underlying population who are treated surgically with those who are treated nonsurgically are needed to delineate the relative benefits and risks of treating patients with degenerative MRI changes. This study should raise awareness regarding the need for more standardized phenotypic definitions of CLBP and their inclusion as part of methodologically rigorous studies.

➢ Key Points

- ❑ There may be an association between degenerative MRI changes and CLBP, but this association must be considered within the context of study quality and the lack of a direct link between degenerative MRI findings and the presence of CLBP.
- ❑ In the absence of deformity or symptomatic neural compression, there is no evidence to demonstrate that surgical treatment of degenerative MRI changes leads to improved outcomes over nonoperative care.
- ❑ Strong recommendations are made against routinely using MRI for the workup for CLBP and against the surgical treatment of CLBP based solely upon degenerative MRI changes.

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