

Clinical Study

Computed tomography–evaluated features of spinal degeneration: prevalence, intercorrelation, and association with self-reported low back pain

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Abstract

BACKGROUND CONTEXT: Although the role of radiographic abnormalities in the etiology of nonspecific low back pain (LBP) is unclear, the frequent identification of these features on radiologic studies continues to influence medical decision making.

PURPOSE: The primary purposes of the study were to evaluate the prevalence of lumbar spine degeneration features, evaluated on computed tomography (CT), in a community-based sample and to evaluate the association between lumbar spine degeneration features. The secondary purpose was to evaluate the association between spinal degeneration features and LBP.

STUDY DESIGN: This is a cross-sectional community-based study that was an ancillary project to the Framingham Heart Study.

SAMPLE: A subset of 187 participants were chosen from the 3,529 participants enrolled in the Framingham Heart Study who underwent multidetector CT scan to assess aortic calcification.

OUTCOME MEASURES: Self-report measures: LBP in the preceding 12 months was evaluated using a Nordic self-report questionnaire. Physiologic measures: Dichotomous variables indicating the presence of intervertebral disc narrowing, facet joint osteoarthritis (OA), spondylolysis, spondylolisthesis, and spinal stenosis and the density (in Hounsfield units) of multifidus and erector spinae muscles were evaluated on CT.

METHODS: We calculated the prevalence of spinal degeneration features and mean density of multifidus and erector spinae muscles in groups of individuals with and without LBP. Using the χ^2 test for dichotomous and *t* test for continuous variables, we estimated the differences in spinal degeneration parameters between the aforementioned groups. To evaluate the association of spinal degeneration features with age, the prevalence of degeneration features was calculated in four age groups (less than 40, 40–50, 50–60, and 60+ years). We used multiple logistic regression models to examine the association between spinal degeneration features (before and after adjustment for age, sex, and body mass index [BMI]) and LBP, and between all degeneration features and LBP.

RESULTS: In total, 104 men and 83 women, with a mean age ($\pm$ standard deviation) of 52.6 ± 10.8 years, participated in the study. There was a high prevalence of intervertebral disc narrowing (63.9%), facet joint OA (64.5%), and spondylolysis (11.5%) in the studied sample. When all spinal degeneration features as well as age, sex, and BMI were factored in stepwise fashion into a multiple logistic regression model, only spinal stenosis showed statistically significant association with LBP,

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odds ratio (OR) (95% confidence interval [CI]): 3.45 [1.12–10.68]. Significant association was found between facet joint OA and low density of multifidus (OR [95% CI]: 3.68 [1.36–9.97]) and erector spinae (OR [95% CI]: 2.80 [1.10–7.16]) muscles.

CONCLUSIONS: Degenerative features of the lumbar spine were extremely prevalent in this community-based sample. The only degenerative feature associated with self-reported LBP was spinal stenosis. Other degenerative features appear to be unassociated with LBP. © 2010 Elsevier Inc. All rights reserved.

Keywords: Low back pain; Computed tomography; Spine; Degeneration

Introduction

Low back pain (LBP) is a pervasive problem that affects two-thirds of adults at some time in their lives [1]. Back pain and its sequelae place an enormous burden on society, health-care systems, and the economies of developed countries [2]. Despite the high prevalence of LBP, little is known about the pathogenesis of this complaint. In clinical practice, some clinicians routinely request imaging to confirm their diagnosis and provide reassurance. Others limit the use to patients who require interventional treatment or who have signs of potentially serious diseases, for they argue that imaging could provide misleading information, generate unnecessary anxiety, and lead to inappropriate treatment [3,4]. The clinical literature includes multiple reports of the high prevalence of degenerative spinal changes in asymptomatic individuals and does not support a significant relationship between such changes and the development of LBP [5–7].

Although the role of radiographic abnormalities in the etiology of nonspecific LBP is unclear, the frequent identification of these features on radiologic studies continues to influence medical decision making with respect to additional evaluation and selection of treatment options. In primary care settings, the most common spine imaging tests for assessing LBP are plain radiography, computed tomography (CT), magnetic resonance imaging (MRI), and bone scanning. Low cost and ready availability make plain radiography the most common of these [8,9]. However, a systematic review of published observational studies found no strong evidence supporting the presence of a causal relationship between radiographic findings and nonspecific LBP [10]. Clinical studies have consistently failed to demonstrate a significant relationship between spinal degeneration and LBP based on data from plain radiographic testing. However, the poor quality of imaging studies has been cited as a potential reason that the relationship between degeneration and LBP could not be defined.

In contrast to radiography, CT optimizes delineation of bony architectural details that are particularly relevant to degenerative disease (Figure). These details include end plate irregularity and sclerosis, spinal stenosis, facet joint osteoarthritis (OA), spondylolysis, and spondylolisthesis. Abnormalities that can be demonstrated and categorized by CT include osteophyte formation; hypertrophy of

articular processes; articular cartilage thinning; vacuum phenomenon in joints and discs; synovial and subchondral cysts; and calcification of the joint capsule, vertebral end plates, and ligaments [11–13]. A review of the clinical literature revealed no CT-based studies evaluating the prevalence of structural abnormalities in the spine and their relation to LBP in an unselected population-based cohort.

The aim of the present study was to evaluate the association between degenerative features of the lumbar spine evaluated on CT and self-reported LBP in a community-based sample. Furthermore, we also examined the relation between different lumbar spine degeneration features including intervertebral disc narrowing, facet joint OA, spondylolysis, spondylolisthesis, and spinal stenosis and the density of multifidus and erector spinae muscles.

Methods

Study design

This is a cross-sectional community-based study that was an ancillary project to the Framingham Heart Study.

Sample

This project was an ancillary project to the Framingham Heart Study. This study began in 1948 as a longitudinal population-based study of the causes of heart disease. Initially, 5,209 men and women living in Framingham, MA, were enrolled. In 1971, 5,124 offspring (and their spouses) of the original cohort were entered into the Offspring cohort. In 2002, 4,095 men and women who were children of the Offspring cohort were enrolled in the Third Generation cohort. A description of the Offspring and Third Generation cohorts has been previously reported [14,15]. Abdominal and chest multidetector CT scanning was performed on 3,529 participants of the Offspring and Third Generation cohorts aged 40 to 80 years to assess coronary and aortic calcification. The recruitment and conduct of CT scanning have been previously reported [16,17]. During the later part of the CT study, 191 participants were consecutively enrolled in this ancillary study to assess the association between radiographic features of the lumbosacral spine and LBP. Four individuals were not analyzed because of insufficient CT data.

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