

2013 Outstanding Paper Runner-up

Patterns of lumbar disc degeneration are different in degenerative disc disease and disc prolapse magnetic resonance imaging analysis of 224 patients

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Received 1 February 2013; accepted 21 October 2013

Abstract

BACKGROUND CONTEXT: Existing research on lumbar disc degeneration has remained inconclusive regarding its etiology, pathogenesis, symptomatology, prevention, and management. Degenerative disc disease (DDD) and disc prolapse (DP) are common diseases affecting the lumbar discs. Although they manifest clinically differently, existing studies on disc degeneration have included patients with both these features, leading to wide variations in observations. The possible relationship or disaffect between DDD and DP is not fully evaluated.

PURPOSE: To analyze the patterns of lumbar disc degeneration in patients with chronic back pain and DDD and those with acute DP.

STUDY DESIGN: Prospective, magnetic resonance imaging–based radiological study.

METHODS: Two groups of patients (aged 20–50 years) were prospectively studied. Group 1 included patients requiring a single level microdiscectomy for acute DP. Group 2 included patients with chronic low back pain and DDD. Discs were assessed by magnetic resonance imaging through Pfirrmann grading, Schmorl nodes, Modic changes, and the total end-plate damage score for all the five lumbar discs.

RESULTS: Group 1 (DP) had 91 patients and group 2 (DDD) had 133 patients. DP and DDD patients differed significantly in the number, extent, and severity of degeneration. DDD patients had a significantly higher number of degenerated discs than DP patients ($p < .000$). The incidence of multilevel and pan-lumbar degeneration was also significantly higher in DDD group. The pattern of degeneration also differed in both the groups. DDD patients had predominant upper lumbar involvement, whereas DP patients had mainly lower lumbar degeneration. Modic changes were more common in DP patients, especially at the prolapsed level. Modic changes were present in 37% of prolapsed levels compared with 9.9% of normal discs ($p < .00$). The total end-plate damage score had a positive correlation with disc degeneration in both the groups. Further the mean total end-plate damage score at prolapsed level was also significantly higher.

CONCLUSION: The results suggest that patients with disc prolapse, and those with back pain with DDD are clinically and radiologically different groups of patients with varying patterns, severity, and extent of disc degeneration. This is the first study in literature to compare and identify significant differences in these two commonly encountered patient groups. In patients with single-level DP, the majority of the other discs are nondegenerate, the lower lumbar spine is predominantly involved and the end-plate damage is higher. Patients with back pain and DDD have larger number of degenerate discs, early multilevel degeneration, and predominant upper lumbar degeneration. The knowledge that these two groups of patients are different clinically and radiologically is critical

FDA device/drug status: Not applicable.

Author disclosures: **RMK:** Grant: Ganga Orthopedic Research and Education Foundation (B, Paid directly to institution). **APS:** Grant: Ganga Orthopedic Research and Education Foundation (B, Paid directly to institution). **SR:** Grant: Ganga Orthopedic Research and Education Foundation (B, Paid directly to institution).

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

Funded by Ganga Orthopedic Research and Education Foundation. This study was approved by Internal Review Board of Ganga Hospital, Coimbatore, India.

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for our improved understanding of the disease and for future studies on disc degeneration and disc prolapse. © 2014 Elsevier Inc. All rights reserved.

Keywords:

Disc degeneration; Disc prolapse; Magnetic resonance imaging; Patterns

Introduction

Despite significant research, the etiology and pathogenesis of disc degeneration are poorly understood [1–10]. The term “disc degeneration” includes such a wide array of clinical, radiologic, and pathologic manifestations as to be considered really “only a symbol of our ignorance” [11]. In addition to the complexity of the disease, the wide variation in description of disc degeneration is also a possible reason for the lack of clarity. Magnetic resonance imaging (MRI) features of disc degeneration include disc dehydration, annular tears, Schmorl nodes, signal intensity changes, reduced disc height, disc bulge, disc prolapse, Modic changes, and osteophytes [12–15]. Existing studies on disc degeneration also have included patients with both degenerative disc disease (DDD) and disc prolapse as a single cohort, often with wide variations in the results [16–23]. The possible relationship or disaffection between disc prolapse and DDD is still unanswered and the knowledge whether these features of disc degeneration are related or unrelated to each other is critical. An intriguing question is whether disc prolapse or disc degeneration are just pathologies affecting that particular involved disc or are they focal manifestation of a diffuse disease of the lumbar discs. A study to compare and analyze the specific patterns of disc degeneration among all the lumbar discs (including disc hydration, Modic changes, Schmorl nodes, end-plate damage) in these patients would be valuable.

We undertook this study to compare two groups of young patients: group 1 with acute disc prolapse and group 2 with chronic back pain and DDD. Only patients between 20 and 50 years of age were selected to avoid age-related degenerative changes. The patterns of disc degeneration among the five lumbar discs (L1–L2 to L5–S1), distribution of Modic changes and Schmorl nodes, and the extent of end-plate damage were studied in the two study groups. We believed that differentiating these two groups of patients would be critically important in patient selection for future studies on disc degeneration and also understand the possible etiopathogenetic mechanisms for disc prolapse and DDD.

Methods

Data were prospectively collected from two groups of patients. Group 1 included consecutive patients (ages 20–50 years) who underwent a single-level lumbar microdiscectomy for acute sciatica (<4 weeks). The presence of typical sciatica along a nerve root, positive nerve root

tension signs, and MRI evidence of significant disc herniation were present in all the patients. The herniated discs included protrusions, extrusions, and sequestrations. None of these patients had any previous history of chronic back pain.

Group 2 included consecutive patients aged between 20 and 50 years with a chronic history of mechanical low back pain. The following pain criteria were mandatory in all the patients: low back pain related to activities, present for >6 months, no history of trauma/infections/tumor/previous spinal interventions, no sciatica, and at least a single-level disc degeneration in any of the lumbar discs. Patients with any structural disorders such as spondylolisthesis, scoliosis, or kyphosis or suspected infection were not included in the study.

Sagittal and axial T1 and T2 MRI sequences were performed in all the patients. Disc degeneration was assessed by Pfirrmann grading and any disc of Pfirrmann grade ≥ 3 was considered as degenerated. In the sagittal images, the presence and number of Schmorl nodes, number and type of Modic changes, and the total end-plate damage score (TEPS) [24] were calculated at each level. The grading was performed by two spine consultants and excellent interobserver reliability (kappa score=0.84) was observed. Any variations in the grading between the observers were reviewed by the senior author and graded appropriately. The results were compared between the two groups and statistical significance was ascertained.

Results

Ninety-one patients had disc prolapse (group 1) with mean age of 39 ± 6 years. The male:female ratio was 57:34. L4–L5 was the most common prolapsed level (N=54) followed by L5–S1 (N=34). A total of 133 patients had degenerative disc disease (group 2) with a mean age of 40 ± 7 years. The male:female ratio was 59:74. The age distribution between the two groups did not have any significant differences. Females were more common in the DDD group ($p < .05$).

Disc degeneration and its pattern

Severity and extent of disc degeneration

The pattern of disc degeneration in the five lumbar discs differed significantly in the group 1 and 2 patients. They significantly differed in the number, extent and severity of disc degeneration.

Patients with DDD had a significantly higher number of degenerated discs (340/665, 51%) in comparison to disc

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