



The Influence of Lumbar Spinal Subtype on Lumbar Intervertebral Disc Degeneration in Young and Middle-Aged Adults

P.A.G. Torrie, MRCS (Eng)*, G. McKay, MRCS (Gla), R. Byrne, Bsc,
S.A.C. Morris, FRCS (Orth), I.J. Harding, BA, FRCS (Orth)

Department of Spinal Surgery, Frenchay Hospital, North Bristol NHS Trust, Beckspool Road, Frenchay, Bristol BS16 1LE, UK

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Abstract

Study Design: Retrospective cohort study.

Objective: To identify whether an in vivo correlation exists between lumbar spinal subtype (LSS) and lumbar disc degeneration (LDD) in young adults.

Summary of Background Data: Lumbar disc degeneration has largely been ascribed to biomechanical and structural alterations to the disc, which are attributed to aging and pathological physical loading. Sagittal alignment in the asymptomatic spine has also been considered. A biomechanical study by Roussouly and Pinheiro-Franco proposed level-specific patterns in LDD. To date, no in vivo correlation between the LSS and LDD has been established.

Methods: The authors screened 608 consecutive patients over 5.3 years. Lumbar spinal subtype and pelvic parameters were collected from standing lumbar radiographs and were categorized using the classification of Roussouly and Pinheiro-Franco. Lumbar disc degeneration at all lumbar intervertebral levels was classified using criteria of Pfirrmann et al. A stratified disc degeneration score was derived for each patient. Lumbar disc degeneration in type I, II, and IV LSS was compared using chi-square test. Pelvic incidence was correlated with stratified disc degeneration score using Spearman R, to determine whether a high PI was protective against LDD. Statistical significance was accepted at $p < .05$.

Results: A total of 139 patients were included, with 91 females and a mean age of 32.6 years (range, 13–49 years). For LSS grades I to IV, there were 10 (7.3%), 43 (30.9%), 50 (35.9%), and 36 (25.9%) patients, respectively. The proportion of high-grade (Pfirrmann grades IV and V) LDD increased distally toward the lower intervertebral levels, affecting 2.88%, 2.9%, 5%, 9.4%, 33.1%, and 54% of discs at each sequential lumbar level from T12–L1 to L5–S1, respectively. Age but not gender was statistically significant for higher-grade LDD ($p < .0001$ and $p = .442$, respectively). Pelvic incidence across all LSS grades was not significantly correlated with stratified disc degeneration score (Spearman $R = 0.0933$; $p = .335$). No LSS (type I–IV) reached statistical significance for a specific pattern of LDD.

Conclusions: In this study, LSS was not statistically significantly correlated with LDD, nor was a high pelvic incidence protective against LDD.

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Keywords: Lumbar disc degeneration; Lumbar spine subtype; Etiology

Introduction

Lumbar intervertebral disc degeneration (LDD) increases with age [1]. In young adults, LDD is present in 40% of individuals under 30 years of age and increases

progressively to over 90% by 50 to 55 years of age [2]. Lumbar disc degeneration is a known major risk factor associated with low back pain [3,4]; Grade IV and V discs on magnetic resonance images (MRIs) indicate discogenic pain in patients with chronic low back pain [5].

To date, disc degeneration has largely been ascribed to biomechanical and structural alterations to the disc, which are attributed to aging and pathological physical loading [6–9]. Other factors reported to be involved in the mechanism of disc degeneration include genetic factors [10–16],

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*Corresponding author. Department of Spinal Surgery, Frenchay Hospital, North Bristol NHS Trust, Beckspool Road, Frenchay, Bristol BS16 1LE, UK. Tel.: +44 7812 566660; fax: +44 1189 417592.

E-mail address: alextorrie99@hotmail.com (P.A.G. Torrie).

environmental factors [17–20], systemic disease [21–26], and hormonal influences [27].

The effect of spinal deformity as a potentially causative mechanism for disc degeneration has been considered in young adults [28–32]. In patients undergoing spinal instrumented fusion a correlation between abnormal sagittal alignment and adjacent segment LDD has also been observed [33,34], whereas in the cervical spine loss of normal lordotic alignment may accelerate disc degeneration owing to altered kinematics [35,36].

Sagittal alignment in the asymptomatic spine has also been thought to have a possible role in the development and progression of LDD [37]. In a study considering lumbosacral morphology and the degree of LDD, Ergün et al. [38] showed the degree and risk of intervertebral LDD and herniation to increase parallel to a decrease in sacral kyphosis and lumbar lordosis (LL) [38]. In a biomechanical study of contact forces acting on the lumbar spine, Roussouly and Pinheiro-Franco [39] proposed expected level-specific patterns of degeneration in the lumbar spine. To date, no *in vivo* correlation has been established between lumbar spinal subtype (LSS) and LDD.

The primary purpose of this study was to identify whether an *in vivo* correlation exists between LSS and pelvic parameters and LDD in young adults. The pre-study hypotheses predicted that LDD would have a predilection

for the thoracolumbar junction (T12–L1 and L1–2) in a type 1 lumbar spine and the lower lumbar levels (L4–5 and L5–S1) in a type 2 lumbar spine, it would be evenly distributed in a type 3 lumbar spine, and it would have no degeneration in a type 4 lumbar spine. The study null hypothesis was that there would be no difference in level-specific predilection for LDD between LSS.

Materials and Methods

This was a retrospective study investigating the association between LSS and LDD. Patients for enrollment in the study were identified from the Patient Archiving Computer System over a 5.3-year period from November, 2007 to March, 2013. Inclusion criteria for the study were: patients under 50 years of age, with standing lumbar plain film radiographs and an MRI lumbar spine scan that had been performed within 1 year of each other. Exclusion criteria for the study were: patients under 10 years or over 50 years of age; postsurgical patients; those with spondylosis, spondylolisthesis, or evidence of surgery (metalwork); imaging conducted in a non-temporal fashion (i.e., scans not performed within 1 year of each other); non-weight-bearing plain film radiographs; patient duplications; and those with cancer, trauma, or inadequate imaging.



Fig. 1. Standing lateral lumbar plain film radiograph with measurements being obtained.

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