ROLE OF FACET ASYMMETRY IN LUMBAR SPINE DISORDERS

L. DAI[1], L. JIA[1]

The correlation between facet joint asymmetry and disorders of the lumbar spine was analyzed in a study of plain radiographs, computed tomograms and magnetic resonance images from 76 normal subjects and 173 patients who underwent lumbar surgery. Of 76 normal controls who were studied by means of plain radiographs, only 21 (27.6%) had facet asymmetry at the level of L4-5 or L5-S1, while 84 (48.6%) of 173 patients who were studied with plain radiographs, and partially with CT or MRI, were noted to have facet asymmetry. The difference was highly significant ($P < 0.01$). This study supports the etiologic significance of facet asymmetry in lumbar disorders.

Keywords : lumbar spine ; intervertebral disc ; facet.
Mots-clés : colonne lombaire ; disque intervertébral ; facette.

INTRODUCTION

Low back pain may be caused by multiple factors. The importance of degeneration and injury of the intervertebral disc has been emphasized, and considerable work has been devoted to herniation of the intervertebral disc and spinal stenosis in the lumbar spine. However, few studies have dealt with the facet joints.

Farfan and Sullivan (7) claimed that asymmetry (tropism) of the facet joint was implicated in lumbar disc disease. We have examined the relationship between facet joint asymmetry and lumbar spine disorders.

SUBJECTS AND METHODS

Normal controls. There were 76 normal adults, including 48 men and 28 women. Their mean age was 36.4 (24-65) years. All the subjects were free from chronic low back pain and/or sciatica.

Patients. One hundred seventy-three patients with complaints of low back pain or sciatica were included in this study. There were 114 men and 59 women with a mean age of 40.6 (23-63) years. The diagnosis was made according to clinical symptoms and imaging examinations, and was proved by operative findings for all the patients (table I).

Methods. Plain radiography, computed tomography (CT) and magnetic resonance imaging (MRI) of the lumbar spine were used to evaluate the symmetry of the facet joints at the L4-5 and L5-S1 levels (table II).

Table I. — Diagnosis of 173 patients

Diagnosis	Patients
Intervertebral disc herniation	141
L4-L5 : 87	
L5-S1 : 54	
Spondylolysis and spondylolisthesis	23
Degenerative spondylolisthesis	9
Total	173

Table II. — Imaging methods used for evaluation of facet joint asymmetry

Groups	Plain Radiography	CT	MRI
76 normal controls	76	–	–
173 patients	173	31	108

[1] Department of Orthopedics, Changzheng Hospital, Shanghai, China.
Correspondence and reprints : L. Dai, Department of Orthopedics, Changzheng Hospital, Shanghai 200003, China.

In a total of 117 patients facet joint inclination (9) was measured (table III). Asymmetry of the facet joints was defined on plain radiographs according to the protocol established by Farfan and Sullivan (7) and expressed with CT and MRI as a difference of at least 10% between measurements of left and right facet joint obliquity (3). Only the measurement results of plain radiography which agreed with that of CT or MRI were adopted. In fact, only three patients who had their radiographs interpreted as inconsistent with CT or MR have not been included in this series. However, in the normal subjects only plain radiographs were taken. The intraobserver error was found to be 1.4° for assessment of obliquity of the facet joints. All measurements were made by only one of the authors so that intraobserver error did not need to be considered.

Statistical analysis. The chi-square test was used for comparison of the results between the two groups.

RESULTS

Of the 76 control subjects, only 21 (27.6%) were identified as having a definite asymmetry of the facet joints by means of plain radiographs. However, asymmetry of facet joints at one level was found in 84 of 173 (48.6%) patients with disorders of the lumbar spine and was statistically highly significant ($\chi^2 = 9.479$, $P < 0.01$) compared with the normal controls. Of these 84 patients with asymmetry of a facet joint, 72 had a disc herniation (40 at the L4-5 level and 32 at the L5-S1 level), 9 had isthmic spondylolisthesis, and 3 degenerative spondylolisthesis. When asymmetry of the facet joint was combined with a disc herniation, more herniations (63/72) occurred on the side of the more oblique facet.

In table III, the difference in inclination between the left and right facet joints at the specified level are presented.

Table III. — Difference in facet joint inclination (°) in 117 patients measured with CT and/or MRI ($\bar{x} \pm SD$)

Difference	L4-L5	L5-S1
Facet symmetry	2.5 ± 1.4 (n = 41)	1.8 ± 0.8 (n = 23)
Facet asymmetry	17.4 ± 5.2 (n = 26)	15.6 ± 2.7 (n = 27)

DISCUSSION

A. Herniated disc and facet joint asymmetry

Facet joints play an important role in lumbar biomechanics. They bear various loads, determine motion between two adjacent vertebrae and provide stability to the spine (4). When the facet joints are injured, stability and stress distribution will be severely disrupted (5, 6). A study by Farfan and Sullivan (7) showed a direct correlation between asymmetric orientation of the facet joints and disc herniation. Indeed, they found that 76 of 78 patients with disc herniation had asymmetry of the facet joints while 94.7% of them had a herniated disc on the side of the more obliquely oriented facet. These findings raised the question of the possible role of the facet joints in the pathogenesis of disc herniation. They suggested that these more obliquely oriented facet joints offer little or no mechanical resistance to axial rotation of the lumbar spine and are unable to protect the disc from injury, as the more oblique facet surface is further loaded by shear forces. In a cadaver study (3) the rotation of the upper vertebra was noted to be more pronounced towards the side of the more oblique facet. The authors (3) proposed that facet tropism might predispose these segments to degenerative changes, and that any bony protuberances or discontinuities in subchondral bone could accelerate the process and lead to osteoarthritis. As the results showed, instability of the lumbar spine and back pain would be induced. In another study, based on MRI and CT, 50% of patients with complaints of low back pain or sciatica were found to have asymmetric facets at the L5-S1 level, and 42% at the L4-5 level (12). It was also suggested that the risk of disc degeneration is increased in the presence of facet joint tropism (13). In our study, the fact that patients with lumbar degenerative diseases had a significantly higher prevalence of asymmetric facets than normal subjects was compatible with these findings.

However, the hypothesis regarding the role of asymmetry of the facet joints in the lumbar degenerative diseases was not fully confirmed by other authors. After examination of the orientation and

shape of the lower lumbar facet joints with low back pain, the correlation between asymmetry of the facet joints and the herniated disc was shown only at the L5-S1 level (2, 10, 14) or at the L4-L5 level (9). Ahmed *et al.* (1) measured the axial torque-rotation response of the lumbar motion segments for a variety of preload conditions and did not demonstrate the role of facet orientation in resistance to axial torque. They maintained that more obliquely oriented facets did not necessarily allow greater axial rotation and increase the risk of torsional disc injury, and that axial rotation sufficient to cause disc injury might only be possible after facet failure. Our study shows no significant difference between the L4-5 and L5-S1 levels. The controversy regarding the relevance of facet tropism in lumbar diseases needs to be resolved by further investigation.

B. Spondylolisthesis and facet joint asymmetry

We found that nine of 23 cases of isthmic spondylolisthesis had facet asymmetry, which is compatible with the hypothesis that lumbar instability and stress concentration in the pars interarticularis induced by facet tropism might cause isthmic stress fractures (11). In all these nine cases the isthmolysis was bilateral and apparently resulted from a unilateral exaggerated obliquity of a facet joint. Developmental sagittal orientation of the facet joints has been thought to be implicated in degenerative spondylolisthesis (8), but there were too few patients included in this group to allow any conclusion to be drawn.

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SAMENVATTING

L. DAI, L. JIA. Rol van de facet-asymmetrie in lumbale wervelkolomaandoeningen.

De correlatie tussen facet-asymmetrie en afwijkingen van de lumbale wervelkolom werd onderzocht door middel van een studie van standaard Rö-opnamen, computertomogrammen en NMR bij 76 normale personen en 173 geopereerde patiënten.
Van 76 normale onderzoeken met standaard RX hadden 21 (27,6%) facet asymmetrie thv. L4/L5 of L5/ S1 ; hiertegen werd een facet-asymmetrie gezien bij 84 (48,6%) van de 173 patiënten die onderzocht werden met standaard RX en gedeeltelijk met CT en NMR. Het verschil was significant ($P < 0,01$). Deze studie bevestigt de rol van facet-asymmetrie bij het ontstaan van lumbale pathologie.

RÉSUMÉ

L. DAI, L. JIA. Rôle de l'asymétrie facettaire dans la pathologie de la colonne lombaire.

La corrélation entre l'asymétrie des facettes et la pathologie de la colonne lombaire fût étudiée à l'aide de la radiographie standard, de tomographies axiales computérisées et de la résonance magnétique nucléaire chez 76 sujets normaux et chez 173 opérés de la colonne lombaire.

Seuls 21 (27,6%) des 76 sujets normaux, examinés par radiographie standard, présentaient une asymétrie facettaire de L4/L5 ou de L5/S1 alors que 84 (48,6%) des 173 malades étudiés à l'aide de radiographies standard et pour certains à l'aide de la tomodensitométrie ou de la RMN présentaient une asymétrie facettaire. La différence était significative ($P < 0,01$). Cette étude illustre le rôle de l'asymétrie facettaire dans la genèse de la pathologie de la colonne lombaire.