The Relationship of Facet Tropism to Lumbar Disc Herniation

Sombat Kunakornsawat MD*, Kitipod Ngamlamaidt MD**, Rachata Tungsiripat MD, MPH*, Thavat Prasartritha MD*

* Center of Excellence in Orthopedics, Lerdsin Hospital, Bangkok, Thailand
** Somdejprapinklao Hospital, Bangkok, Thailand

Summary of Background Data: The association between the facet tropism and the development of lumbar disc herniation has been studied; however the results remain controversial.

Objective: To determine the association between the facet tropism and the development of lumbar disc herniation.

Study design: A cross-sectional study.

Material and Method: MRI of 34 patients with lumbar disc herniation was evaluated. Two orthopedic surgeons measured facet joint angle and determined the degenerative status of L3-4, L4-5, and L5-S1. Facet tropism was defined as the difference between the angle of the right and left facet more than 5 degrees.

Results: The average difference of facet joint angle of HNP group was higher than normal group in the same level. There was no statistically significant correlation between the facet tropism and lumbar disc herniation.

Conclusion: These results do not indicate any relationship between the facet tropism and lumbar disc herniation.

Keywords: Facet tropism, Lumbar disc herniation

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Fig. 1 Measuring the facet joint angles
A reference line (A and B) is drawn tangential to posterior aspect of the disc space
Other reference lines are drawn tangential to the anteromedial and posterolateral edges of the superior articular facet bilaterally
The angles ($\alpha_R$ and $\alpha_L$) between these lines are called the facet joint angles

Fig. 2 MRI of the lumbar spine, demonstrating how the facet joint angles were measured relative to the coronal plane (horizontal line)

The degree of disc degeneration at herniated disc level was measured by using sagittal T2-weighted images. Normal disc was described as un-collapsed disc space with no evidence of herniation. Disc signal in T2 weight was clear white with smooth border of annulus fibrosus and nucleus pulposus\(^{(11)}\). A disc found different from the criteria above was classified as degenerative disc disease.

**Statistical analysis**
Kappa statistic was used to evaluate the interobserver and intra-observer reliability. Kappa index more than 0.8 indicated limited variation of measurement and evaluation, less than 0.2 indicated very large variation. The mean, range, and standard deviation (SD) were calculated for continuous variables while categorical variables were number and percent. The association between degree of facet tropism and herniated disc is evaluated by using Chi-square test, Fisher’s exact test, and odds ratio with 95% confidence interval (95% CI). A p-value < 0.05 was considered statistically significant.

**Results**
MRI of 34 patients was retrieved. There were 22 males and 12 females. Average age was 34 years old (range 23-45). Overall, there were 102 motion segments, equally distributed to L3-4, L4-5, and L5-S1. Twenty-four herniated discs were found at L4-5, 1 at L3-4 and 9 at L5-S1. All adjacent levels of herniated disc had normal disc.
In the herniated disc group, average facet joint angle (inclination) at level L3-4, L4-5, L5-S1 was 65, 44.3, and 39.8 degrees respectively. Facet joint angle at L4-5 in HNP group was similar to normal. While that of L5-S1 was smaller than that of control (Table 1). The average difference of facet joint angle in all three levels of HNP group was higher than the normal group (Table 2).

Table 3 indicates the association between the facet tropism and herniated disc. For L4-5, 13 of the 17 subjects with facet tropism were diagnosed as herniated disc, compared with 11 of 17 of the no facet tropism group. The Odds ratio of herniated disc in subjects with facet tropism at L4-5 and L5-S1 were 1.8 (95% CI = 0.32-10) and 1.7 (95% CI = 0.3-10). There was no correlation between facet tropism and herniated nucleus pulposus in all levels (p > 0.05).

The reliability of the facet tropism measurement method using MRI was very impressive. Intra-observer and inter-observer reliability were 0.9 and 0.8 respectively.

Discussion

The facet joints play an important role in the disc degeneration process. In 1967, Farfan HF found that rotational shear force could affect degenerative disc. He also explained that asymmetry of facet joints caused more shear load in axial rotation and result in increased torsional stress at the annulus fibrosus. In 1984, Yang KH and King AI found that compressive load to facet joint was 3-25%.

In 1980, Cyron and Hutton reported a biomechanical study of repetitive axial loading in cadaveric spines. He postulated that the coronal oriented facet joint has a little resistant to external shear force, so the joint tends to rotate toward the side of the coronary oriented facet joint. Schaik studied the patients with back or leg pain by CT study of facet joints. He reported correlation between facet tropism and degenerative spondylolisthesis. Furthermore, some studies' found correlation between sagittal orientation of facet joint and degenerative spondylolisthesis. Lee found that at L3-4 level, level with HNP had a high degree of facet tropism (6.25 degree) compared with normal L3-L4 (3.58) (p < 0.05).

There are several reports that found no relationship between facet tropism and disc degeneration. Adam and Hutton reported facet joint was primary resistant to torsion stress but axial torsion was not an important factor for causing disc degeneration. In 1990, Hagg and Wallner reported facet orientation using CT measurement had an error of 3 to 4.6 degrees. Ahmed AM et al found no relationship between facet asymmetry and axial torque - rotation response in the biomechanical study. He reported facet joint worked as "positive stop" to axial rotation and did not relate

**Table 1.** The facet joint angle in herniated disc and normal disc groups

<table>
<thead>
<tr>
<th>Level</th>
<th>HNP (mean ± SD) (range) n = 34</th>
<th>Normal disc (mean ± SD) (range) n = 34</th>
</tr>
</thead>
<tbody>
<tr>
<td>L3-L4</td>
<td>64.00 ± 4.28 (60-68)</td>
<td>49.89 ± 10.28 (28-70)</td>
</tr>
<tr>
<td>L4-L5</td>
<td>44.30 ± 11.43 (14-68)</td>
<td>43.90 ± 12.22 (18-60)</td>
</tr>
<tr>
<td>L5-S1</td>
<td>39.86 ± 9.88 (20-60)</td>
<td>44.60 ± 9.19 (23-68)</td>
</tr>
</tbody>
</table>

**Table 2.** The degrees of difference between the facet joint angle of both sides in herniated disc and normal disc group

<table>
<thead>
<tr>
<th>Level</th>
<th>HNP (mean ± SD) (range)</th>
<th>Normal disc (mean ± SD) (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L3-L4</td>
<td>8.00 ± 0.00 (0-10)</td>
<td>3.33 ± 2.68 (0-10)</td>
</tr>
<tr>
<td>L4-L5</td>
<td>6.53 ± 4.69 (0-21)</td>
<td>5.45 ± 4.56 (0-15)</td>
</tr>
<tr>
<td>L5-S1</td>
<td>5.00 ± 3.46 (0-10)</td>
<td>4.00 ± 3.54 (0-16)</td>
</tr>
</tbody>
</table>

**Table 3.** The association between facet tropism and herniated disc in each level

<table>
<thead>
<tr>
<th>Level</th>
<th>Facet tropism</th>
<th>Herniated disc</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>L3-4</td>
<td>Yes</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>24</td>
<td>0</td>
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<tr>
<td>L4-5</td>
<td>Yes</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>L5-S1</td>
<td>Yes</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>22</td>
<td>5</td>
</tr>
</tbody>
</table>
with degree of facet orientation. Several reports revealed that facet joints were important structure resisting axial torque\(^8,10,18,19\). Lewin in 1964, found facet joint had degenerative changes in people aged more than 45 years old. The characteristic of hypertrophic “lipping” of superior facet can cause error in measurement of facet joint angle.

In this present study, the authors found that subjects with facet tropism at L4-5 and L5-S1 were 70% more likely to develop herniated disc. However, it is not statistically significant (p < 0.05). Based on the rather weak strength of association (OR = 1.7) and the wide confidence interval (0.2-10), further studies with a large number of subjects were recommended.

There were several limitations in the current study. The first is that the number of cases included in the present study was relatively small. Second, the authors used normal adjacent disc of herniated level as the control group. According to the high cost, the authors could not afford the cost of MRI in the normal population as the control group. Various studies used the adjacent levels as controls\(^8,16\). However, the authors suggested a further study using normal population as control. Although the measurement of facet joint angle from MRI axial T-1 weight image is less accurate than measurement from computed tomography (CT) image\(^20-22\), the authors found the reliability of this measurement method was high. Boden also found the high correlation coefficient of MRI and CT scan in evaluating facet joint angle\(^23\). The authors realized that potential of MRI on the measurement of facet joint angle.

In conclusion, the current study did not find the strong evidence supporting the influence of facet tropism on disc herniation.

References

