

The Orientation of Facet Joints and Transverse Articular Dimension in Degenerative Spondylolisthesis

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Objectives: To determine whether the orientation of facet joints, facet tropism and transverse articular dimension could play a role in degenerative spondylolisthesis.

Material and Method: MRI study of L₄₋₅ level of twenty degenerative spondylolisthesis and age-matched twenty control group were included. The orientation of facet joints, transverse articular dimension (TAD) and cosine facet orientation of TAD were measured with two independent observers.

Results: The facet orientation of more than 43° and cosine facet orientation of TAD less than 7.4 were statistically significant for developing degenerative spondylolisthesis ($p < 0.05$).

Conclusion: The facet orientation of degenerative spondylolisthesis patients was more sagittal orientation than the control group, and the cosine facet orientation of TAD was also less than the control group.

Keywords: Orientation of facet joints, MRI study LS spine, Degenerative spondylolisthesis

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There are many studies suggesting an association between orientation of the facet joints and degenerative spondylolisthesis⁽¹⁻⁷⁾. The role of facet tropism, a significant difference between the left and right facet orientation, on degenerative spondylolisthesis is not well established but one⁽⁸⁾. Most studies demonstrated the correlation between the facet tropism and disc degeneration⁽⁹⁻¹⁵⁾. The purpose of the present study was to classify the relationship between facet joints orientation and transverse articular dimension with degenerative spondylolisthesis by using an MRI study.

Material and Method

The authors ran a prospective study by calculating the sample size using the Botcher's technique of measuring facet orientation and the mean facet angle of 45 degrees relative to the coronal plane as the risk of developing degenerative spondylolisthesis.

The MRI of LS spine at the level of superior endplate of L5 of twenty cases of degenerative spondy-

lolisthesis (male 5 cases and female 15 cases) and twenty control cases (male 11 cases and female 9 cases).

The measurement of facet orientation, transverse articular dimension and cosine facet orientation of transverse articular dimension were done by two independent observers, using image capture software microcomputer (Advantage window 2.0, 3-D analysis) (Fig. 1).

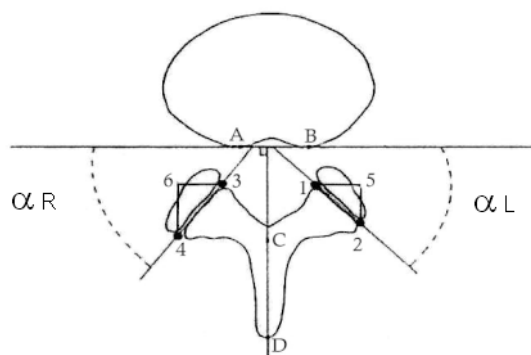


Fig. 1 The measurement of facet orientation (αR, αL) transverse articular dimension (1 to 2 and 3 to 4) and cosine facet orientation of TAD (1 to 5 and 3 to 6)

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The validation of measurement technique of interobserver error was also completed using Pearson correlation. The data and statistical analysis of correlation between the two groups used odds ratio with $p < 0.05$ as statistical significance.

The inclusion criteria were degenerative spondylolisthesis of age 40 and also an age-matched control group. The age distribution of both groups was 40-65 and 43-65 years old, respectively. The exclusion criteria were history of trauma, tumor or surgery at the lower lumbar spine. The MRI of the lumbar normal spine of control group were labeled as normal. The degree of spondylolisthesis was grade I and II according to Meyer's classification.

The difference of sex ratio in degenerative spondylolisthesis and the control group was due to the prevalence of degenerative spondylolisthesis being common in female.

Results

The results of the measurement of degenerative spondylolisthesis and control group and the validation and reproducibility of the measurement technique using Pearson correlation are demonstrated in Table 1, which shows no difference in measurement between observer 1 and observer 2 which may represent accuracy of this technique.

Comparison between degenerative spondylolisthesis and the control group showed that the degenerative spondylolisthesis had more mean facet orientation and less cosine facet orientation of TAD.

Mean facet orientation of 43° or more and cosine facet orientation of TAD less than 7.4 have a relative risk of developing degenerative spondylolisthesis significantly.

Discussion

An association between sagittal orientation of the facet joints and degenerative spondylolisthesis has been suggested. Boden et al⁽¹⁵⁾ described his measurement technique and concluded that an individual in whom both facet joints angles at the level of the fourth and fifth lumbar vertebrae were more than 45 degrees relative to the coronal plane was 25 times more likely to have degenerative spondylolisthesis (95 percent confidence interval seven to ninety-eight times). Boden et al⁽¹⁵⁾ did not find any correlation of facet tropism and degenerative spondylolisthesis. Dai⁽¹⁶⁾ reported that patients with degenerative spondylolisthesis had more sagittally oriented facet joints ($p < 0.01$) and more significant facet joint tropism ($p < 0.05$) than normal control subjects. He concluded that the morphological abnormalities of the lumbar facet joints are a predisposing factor in the development of degenerative spondylolisthesis.

With these differences of Boden et al⁽¹⁵⁾ and Dai⁽¹⁶⁾, the authors examined them and also measured the TAD and cosine TAD in order to find the relationship of TAD and the cosine facet orientation of TAD which represent the length of facet joints in the sagittal plane about the force to develop spondylolisthesis. The facet tropism played no role in degenerative spondylolisthesis in the present study.

The present findings demonstrated that the facet orientation of more than 43 degrees and cosine facet orientation of TAD less than 7.4 were statistically significant for the development of degenerative spondylolisthesis. The TAD itself was not correlated with degenerative spondylolisthesis.

The clinical relevance of the present study was to recommend prevention of development of

Table 1. Validation and reproducibility of the measurement

Variation	Observer 1	Observer 2	Pearson correlation Coefficient*
Cosine of TAD Lt. facet	8.81 ± 2.68	9.00 ± 2.85	0.984
Cosine of TAD Rt. facet	9.47 ± 2.15	9.55 ± 2.28	0.977
Mean cosine TAD	9.15 ± 2.32	9.30 ± 2.47	0.985
Lt. facet orientation	47.68 ± 14.09	47.90 ± 14.10	0.999
Rt. facet orientation	44.95 ± 11.36	45.18 ± 11.61	0.998
Mean facet orientation	46.53 ± 12.61	46.52 ± 12.62	0.994
Lt. TAD	13.45 ± 1.28	13.73 ± 1.24	0.871
Rt. TAD	13.63 ± 1.31	13.78 ± 1.31	0.888
Mean TAD	13.53 ± 1.19	13.75 ± 1.17	0.905

*Correlation is significant at the 0.01 level (2-tailed)

degenerative spondylolisthesis in patients who have facet orientation of more than 45 degrees and cosine orientation of TAD less than 7.4 by rehabilitation means and an education programme.

The orientation facet of TAD is only one plane length, if the authors can measure the area of both facet joints and calculate the cosine of the area as cosine facet orientation of facet area may be more useful than cosine facet orientation of TAD.

Conclusion

The facet orientation of more than 43 degrees and cosine facet orientation of TAD less than 7.4 are statistically significant in the development of degenerative spondylolisthesis.

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ผลของ Orientation of Facet Joints และ Transverse Articular Dimension ต่อการเกิด Degenerative Spondylolisthesis

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วัตถุประสงค์: เพื่อกำหนดหาผลของ Orientation of facet joints, facet tropism และ transverse articular dimension มีบทบาทต่อการเกิด degenerative spondylolisthesis

วัสดุและวิธีการ: ทำการศึกษาสนามแม่เหล็กไฟฟ้ากระดูกสันหลังส่วนบั้นเอวระดับที่ 4 และ 5 ในกลุ่มคนไทย 2 กลุ่ม กลุ่มละ 20 คน ที่พบวัยใกล้เคียงกัน

ผลการศึกษา: ค่าต่าง ๆ ดังกล่าวมีความแตกต่างใน 2 กลุ่ม อย่างไรก็ตามพบว่า Orientation of facet joint น้อยกว่า 43° และ Cosine facet orientation of TAD น้อยกว่า 7.4 มีผลต่อการเกิดในกระดูกสันหลังเคลื่อนอย่างมีนัยสำคัญทางสถิติ ($P < 0.05$)

สรุป: ค่า Facet orientation ใน Degenerative spondylolisthesis จะอยู่ในแนว Sagittal มากกว่าคนปกติและ Cosine facet orientation of TAD จะมีค่าน้อยกว่าในคนปกติ
