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Original Article

Incidence of spinal instability among patients with discogenic low back pain with different backgrounds

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Abstract. [Purpose] To investigate the incidence of spinal instability among patients with discogenic low back pain and its various effects with respect to the patients' age, gender, sports activity, and occupation. [Participants and Methods] We assessed 65 patients diagnosed with discogenic low back pain at our clinic between May 2016 and May 2020. After measuring segmental angulation using plain radiographs, we divided these patients into two groups: (1) instability group with >10° of segmental angulation or >3 mm of sagittal translation and (2) stability group with <10° of segmental angulation and <3 mm of sagittal translation. Patient data such as age, gender, sports activity, and occupation were collected using their medical records. [Results] The incidence of spinal instability was 57% (37 patients) among the patients with discogenic low back pain. No significant differences in age, gender, sports activity, and occupation were identified between the groups. [Conclusion] The incidence of spinal instability accounted for more than half of the total number of patients. Additionally, age, gender, sports activity, and occupation did not affect the incidence of spinal instability. Our results support the importance of rehabilitation, such as stability training for spinal instability, for patients with discogenic low back pain.

Key words: Discogenic low back pain, Lumbar spinal instability, X-ray images

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INTRODUCTION

Discogenic low back pain is a nonspecific form of low back pain that is difficult to diagnose using X-ray images or magnetic resonance imaging findings[1)]. Mechanical stress and facet joint instability have been reported as the causes of discogenic low back pain. Inflammatory cytokines are stimulated because of mechanically stressed intervertebral discs, which stimulate the nerve endings, leading to low back pain[2–5)]. When the intervertebral discs undergo mechanical stress in daily life or during sports movements, patients typically experience specific forms of low back pain, including disc herniation, lumbar spinal stenosis, and spondylosis[6, 7)]. Therefore, evaluation of facet joint displacement for discogenic low back pain and formulation of a treatment strategy based on findings are important. Previous study has reported that cases with instability at the L4/5 level have the most clinical symptoms[8)].

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To evaluate lumbar spinal instability, it is necessary to measure the segmental angulation and sagittal translation. Lumbar spinal instability is a form of instability that occurs when the difference in segmental angulation between the trunk maximum flexed and extended positions is 10° or more, and the difference in sagittal translation between the trunk maximum flexed and extended positions is 3 mm or more[9]. There is no consensus regarding the extent of lumbar instability that causes clinical symptoms. Iguchi T et al showed that the combination of segmental angulation over 10° and sagittal translation over 3 mm causes lumbar and lower limb symptoms[8]. However, the patients in their study had lumbar diseases that included specific forms of low back pain, such as lumbar disc herniation, lumbar spinal stenosis, and spondylosis. A Few studies have investigated segmental angulation and sagittal translation in patients with nonspecific discogenic low back pain.

The present study aimed to investigate the incidence of lumbar spinal instability in patients with discogenic low back pain and examine the effects of patients' age, sports activity, and occupation on lumbar spinal instability. The findings of discogenic low back pain with lumbar spinal instability can help in the prevention of specific forms of low back pain and development of physiotherapy strategies. We hypothesized that patients with discogenic low back pain will have a high rate of lumbar spinal instability.

PARTICIPANTS AND METHODS

We enrolled 65 patients who were diagnosed with discogenic low back pain at the L4/5 lumbar spine level between May 2016 and May 2020 and subsequently underwent rehabilitation. We excluded cases that were difficult to evaluate due to scoliosis or injury caused by a traffic accident (Fig. 1).

Segmental angulation and sagittal translation were measured using SHIMADZU PRO speed Pro X-rays. The measurement position was imaged in the side-lying position, with trunk maximum flexed and extended positions (Fig. 2).

For segmental angulation, we calculated the difference from the angle formed between the lower edge of the L4 vertebral body and the upper edge of the L5 vertebral body during both trunk maximum flexed and extended positions (Fig. 3). Based on previous studies[8, 9], lumbar instability was defined as a segmental angulation of 10° or more.

Sagittal translation was defined as the difference between the anterior-posterior translation of the L4 vertebral body during trunk maximum flexed and extended positions (Fig. 4). Measurement of instability was done using the method of Nachemson A et al[9] which is the most commonly used one. Sagittal translatory instability is diagnosed when the translation is 3 mm or more[8–10]. These measurements were performed for patients with low back pain, the trunk flexion and extension were measured within a pain-free range. Image analysis by the same examiner (intraclass correlation coefficient [1,1], $p<0.05$) showed that the first and second values of segmental angulation and sagittal translation were 0.915 (95% confidence interval [CI], 0.875–0.955) and 0.856 (95% CI, 0.792–0.902), respectively.

We divided the patients into the following two groups: (1) instability group with more than 10° of segmental angulation or more than 3 mm of sagittal translation and (2) stability group with less than 10° of segmental angulation and less than 3 mm of sagittal translation. The patients' age, gender, sports activity, and occupation were investigated using their medical records.

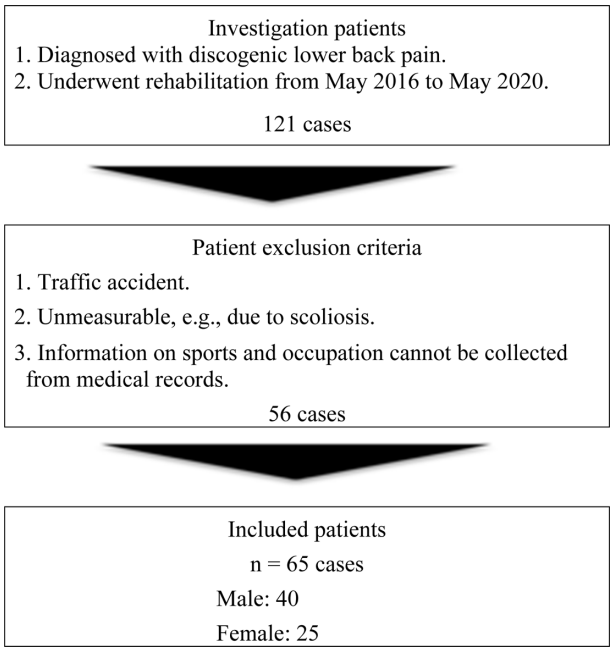

Fig. 1. Enrollment of patients of this study.

The Mann-Whitney U test was used to compare the two groups with respect to the patients' age, whereas the Pearson χ^2 test was utilized to compare the two groups in terms of gender, sports activity, and occupation. R Commander software version 2.8.1 was used for statistical processing, and the significance level was set at 5%.

This study was approved by the Ethics Committee of Hitachino Orthopedic Clinic (protocol number: 202001). Because this was a retrospective study, there were no adverse events among patients. Accordingly, the requirement for acquisition of informed consent was waived owing to the retrospective nature of this study.

Fig. 2. Measurement positions.
The segmental angulation and sagittal translation were measured in the side-lying position at the both trunk maximum flexed and extended positions.

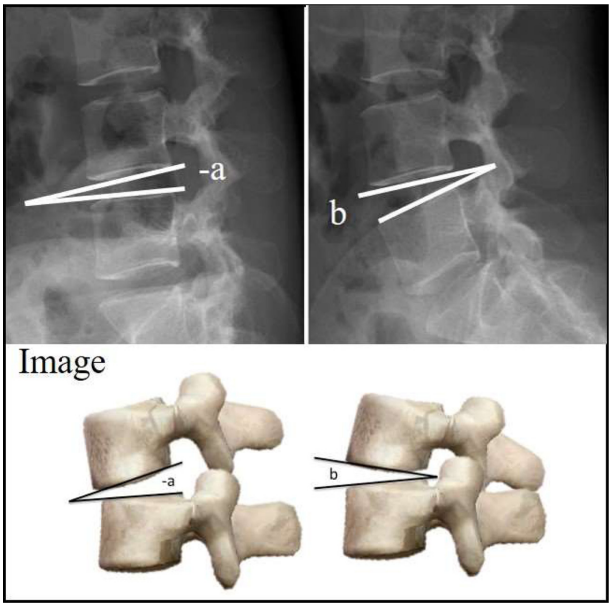

Fig. 3. Method of measuring segmental angulation.
The segmental angulation calculated the difference of intervertebral angle between the trunk maximum flexed and extended positions.
Segmental angulation (°)=b −(−a).

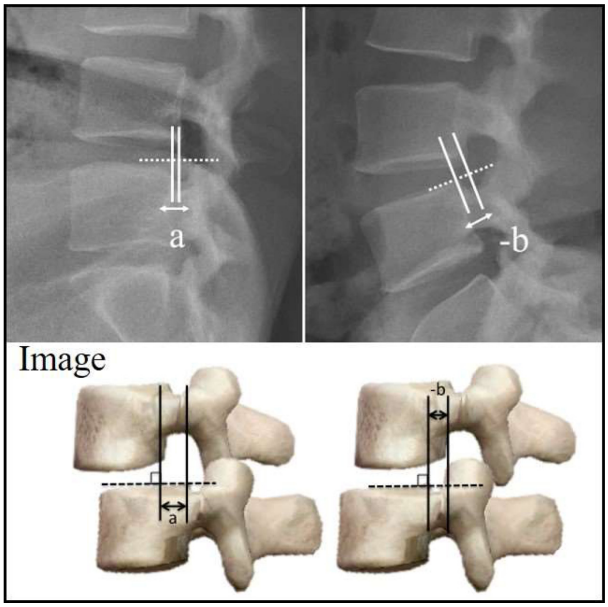

Fig. 4. Method of measuring sagittal translation.
The sagittal translation calculated the difference between the two lines perpendicular to the baseline and passing two landmarks at posterior inferior edge of L4 and superior posterior edge of L5 vertebra when the trunk maximum flexed and extended positions.
Sagittal translation (°)=a −(−b).

RESULTS

Among patients, the mean segmental angulation was 9.6 ± 3.9°, and the mean sagittal translation was 1.3 ± 1.3 mm. The segmental angulation and sagittal translation in the stability group and the instability group were 6.3 ± 2.3° and 0.9 ± 1.1 mm, and 12.1 ± 2.8° and 1.6 ± 1.3 mm respectively. The stability and instability groups consisted of 28 (43%) and 37 (57%) patients. In detail, 28 patients (43%) had no abnormal findings related to segmental angulation and sagittal translation. Furthermore, 30 patients (46%) had a single finding of segmental angulation >10°, whereas 2 patients (3%) had a single finding of sagittal translation >3 mm. There were 5 cases (8%) of combined segmental angulation and sagittal translation (Table 1).

The mean patient age was 39.9 ± 8.2 years in the instability group and 40.6 ± 7.2 years in the stability group. With respect to gender, sports activity, and occupation, 24 males and 13 females were in the instability group, of whom 16 patients participated in regular sports activities and 21patients did not sport. Additionally, 13 were desk workers and 24 were manual workers in the instability group. The stability group consisted of 16 males and 12 females, of whom 12 pattens participated in regular sports activities and 16 patients did not sport; 14 patients were desk workers and 14 patients were manual workers. No significant differences in age, gender, sports activity, and occupation were observed between the instability and stability groups (Table 2).

DISCUSSION

Our study showed that 57% of patients had more than 10° of segmental angulation or more than 3 mm of sagittal translation. In comparison, a previous study[8] reported that approximately 20% of patients had more than 10° of segmental angulation or more than 3 mm of sagittal translation. In our study, the incidence of lumbar spinal instability was higher, and the patients in this study had nonspecific discogenic low back pain with less severe intervertebral disc degeneration. In contrast, the aforementioned previous study[8] investigated specific forms of low back pain with lumbar and lower limb symptoms. As intervertebral disc degeneration progresses, osteophytes formation at the vertebral bodies and facet joints, leading to degenerative spondylosis, which may lead to bony stability with reduced flexibility[6, 7]. Thus, more than half of patients in this study with discogenic low back pain, which would represent the early stage of degeneration that can progress to specific

Table 1. Incidence of lumbar spinal instability (n=65)

Findings	Case (%)	Segmental angulation (°)	Sagittal translation (mm)
Stability	28 (43)	6.3 ± 2.3	0.9 ± 1.1
Instability	37 (57)	12.1 ± 2.8	1.6 ± 1.3
Single			
SA>10°	30 (46)		
ST>3 mm	2 (3)		
Comprex			
SA>10° & ST>3 mm	5 (8)		

Stability: Less than 10° of segmental angulation and 3 mm of sagittal translation.
Instability: More than 10° of segmental angulation or 3 mm of sagittal translation.
SA>10°: More than 10° of segmental angulation, ST>3 mm: More than 3 mm of sagittal translation.
Mean ± standard deviation.

Table 2. Comparison of age, gender, sports activity and occupation in instability and stability group

	Instability group n=37	Stability group n=28	p value
Age (years)	39.9 ± 8.2	40.6 ± 7.2	0.598
Gender (case)			
Male	24	16	0.610
Female	13	12	
Sports activity (case)			
Yes	16	12	0.975
No	21	16	
Occupation (case)			
Desk worker	13	14	0.313
Manual labor	24	14	

Instability group: More than 10° of segmental angulation or 3 mm of sagittal translation.
Stability group: Less than 10° of segmental angulation and 3 mm of sagittal translation.

forms of low back pain, may exhibit lumbar spinal instability in the future. Additionally, the previous study[8] reported that lumbar instability with both sagittal translation and segmental angulation correlate with lower limb symptoms. Future studies should examine the relationships between imaging and the course of symptoms, and a specific physical therapy strategy should be considered for patients with discogenic low back pain.

The results of this study indicated no significant differences between the instability and stability groups in terms of patient age. In contrast, Iguchi T et al reported that the patients in a group showing more than 10° of segmental angulation were younger than those in a stability group showing less than 10° of segmental angulation[8]. This previous study included patients with specific forms of low back pain such as disc herniation and spinal canal stenosis. In contrast, the present study focused on investigating patients with nonspecific discogenic low back pain. Therefore, it did not have a difference in ages in both groups. Compared to the previous study[8], the present study might have investigated young patients whose spinal column degeneration had not progressed as average age of the patients in this study was 39.9 years and the previous study was 47.5 years.

The results of the present study also indicated no differences between the instability and stability groups with respect to sports activity and occupation. As the lumbar spine is the center of the trunk, loads and mechanical stress are applied to the lumbar spine during sports activity. Such sports activity may cause intervertebral disc degeneration and lumbar spinal instability. Nonetheless, Nachemson[11] reported that the intervertebral disc pressure was higher in the sitting position than in the standing position. Therefore, long hours of deskwork may lead to intervertebral disc degeneration and instability. Previous studies showed that intervertebral disc degeneration, which was assessed as high-intensity changes in the endplates of the vertebral bodies using T2-weighted magnetic resonance images[2, 3, 12, 13], could cause lumbar instability and low back pain. Our study revealed no significant differences in segmental angulation, which may confirm the finding that sports movement, physical labor, and deskwork can all cause disc burden and facet joint instability.

As the values measured in this study were drawn from data obtained from patients with low back pain, a significant number of patients might have lumbar spinal instability without pain. In the present study, examinations were performed with the patients lying on their sides in order to avoid aggravating their low back pain.

In conclusion, the incidence of lumbar spinal instability among patients with discogenic low back pain was 57% (more than 10° of segmental angulation or more than 3 mm of sagittal translation). The lumbar spinal instability and stability groups showed no significant differences with respect to age, gender, sports activity, and occupation. Our study results imply that the patients who work as an office already sitting for many hours, which already has increased the load to their disks. Therefore, 57% of participants had disk instability that would support the importance of rehabilitation especially stability training for lumbar spinal instability in patients with discogenic low back pain.

Funding

None.

Conflict of interest

The authors declare no conflicts of interest associated with this study.

REFERENCES

1) Deyo RA, Weinstein JN: Low back pain. N Engl J Med, 2001, 344: 363–370. [Medline] [CrossRef]
2) Modic MT, Masaryk TJ, Ross JS, et al.: Imaging of degenerative disk disease. Radiology, 1988, 168: 177–186. [Medline] [CrossRef]
3) Modic MT, Steinberg PM, Ross JS, et al.: Degenerative disk disease: assessment of changes in vertebral body marrow with MR imaging. Radiology, 1988, 166: 193–199. [Medline] [CrossRef]
4) Burke JG, Watson RW, McCormack D, et al.: Intervertebral discs which cause low back pain secrete high levels of proinflammatory mediators. J Bone Joint Surg Br, 2002, 84: 196–201. [Medline] [CrossRef]
5) Dudli S, Liebenberg E, Magnitsky S, et al.: Propionibacterium acnes infected intervertebral discs cause vertebral bone marrow lesions consistent with Modic changes. J Orthop Res, 2016, 34: 1447–1455. [Medline] [CrossRef]
6) Kirkaldy-Willis WH: Presidential symposium on instability of the lumbar spine. Spine, 1985, 10: 254. [CrossRef]
7) Kirkaldy-Willis WH, Farfan HF: Instability of the lumbar spine. Clin Orthop Relat Res, 1982, (165): 110–123. [Medline]
8) Iguchi T, Kanemura A, Kasahara K, et al.: Lumbar instability and clinical symptoms: which is the more critical factor for symptoms: sagittal translation or segment angulation? J Spinal Disord Tech, 2004, 17: 284–290. [Medline] [CrossRef]
9) Nachemson A: Symposium: the role of spine fusion for low-back pain. International Society for the Study of the Lumbar Spine, New Orleans, Louisiana, May 27, 1980. Spine, 1981, 6: 277–314. [Medline]
10) White AA III, Panjabi MM: Clinical biomechanics of the spine, 2nd ed. Baltimore: Lippincott Williams & Wilkins, 1990, pp 351–357.
11) Nachemson A: Electromyographic studies on the vertebral portion of the psoas muscle; with special reference to its stabilizing function of the lumbar spine. Acta Orthop Scand, 1966, 37: 177–190. [Medline] [CrossRef]
12) Fujiwara A, Tamai K, An HS, et al.: The relationship between disc degeneration, facet joint osteoarthritis, and stability of the degenerative lumbar spine. J Spinal Disord, 2000, 13: 444–450. [Medline] [CrossRef]
13) Toyone T, Tanaka T, Kato D, et al.: Low-back pain following surgery for lumbar disc herniation. A prospective study. J Bone Joint Surg Am, 2004, 86: 893–896. [Medline] [CrossRef]